DIFFERENTIAL INFLATION: RELATIVE IMPACTS UPON DIVERSIFIED AND SINGLE-INDUSTRY FIRMS

By

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The effect of differential inflation or high relative price dispersion on firm value is analyzed. Periods of high relative price dispersion are not only characterized by a wide dispersion of inflation rates across different product sectors, but also by increased uncertainty in individual product sectors. The analytical result of an increased riskiness of real earnings and higher risk-adjusted discount rates of individual firms and therefrom the unsatisfactory performance of the stock market in these periods, is deduced. Since periods of high relative price dispersion accompany high inflationary periods, the analysis extends to the latter periods.

Differential inflation may affect different firms to different degrees. Specifically, a multi-industry firm or conglomerate consisting of subsidiaries involved in different and essentially unrelated product sectors may weather the debilitating effects of differential inflation--increased riskiness of earnings and poor performance of stocks--better than the single-industry firm. Theoretically, it was determined that if conglomeration left the output decision of the firm unaffected, the multi-product firm would be relatively insulated from the increased risk caused by differential inflation, when compared to a single-product firm of the same size. The complications of changes in output decision caused by conglomeration and of size, earnings, debt and interest expense of conglomerates being several times those of specialized firms would tend to neutralize diversification's effect.

The period 1970 through 1981 was classified into four consecutive periods of either high or low relative price dispersion. Conglomerates identified as being 'diversified' by using an index similar to the Herfindahl index commonly used to describe industry concentration, formed the first, and single-industry companies the second, group, for which a comparison of changes in the total risk of real earnings, mean stock return, total risk and estimated systematic risk of stock return, caused by differential inflation was made, using both parametric and non-parametric tests. The total risk of all companies' real earnings were unaffected, the total risk of stock returns increased and the mean stock return and estimated systematic risk fell in periods of differential inflation. However, conglomerate and single-industry firms were found to be affected equally.

CHAPTER I
INTRODUCTION

The effect of a high relative price dispersion upon the earnings and the value of specialized and conglomerate firms constitutes the central theme of this dissertation. A period of high relative price dispersion is characterized by a wide dispersion in the inflation rates in the price indices of different product sectors. Relative price dispersion would be present at all periods in time, but its magnitude or degree could be different in different periods. It is likely to be highest in periods of high inflation. This dissertation is concerned with the impact of a high relative price dispersion or differential inflation on the value of the firm.

Relative price dispersion could affect a firm's earnings. If the price of the firm's output lags wages and other input costs, if input costs rise, earnings would fall. However, if the price of the firm's output leads wages and other costs, its earnings would rise. In either case, there is a degree of risk in the firm's earnings, contributed by high relative price dispersion and the higher the magnitude of relative price dispersion, the greater the risk. The increase in riskiness of the firm's earnings would affect the value of the firm, as can be seen from the following analysis.

If X is the earnings of the firm in period t, T is its tax rate, k its real cost of capital, D its depreciation, r is the risk-free interest rate and n the firm's expected lifetime, then at period 1, the value of the firm would be:

$$V = \sum_{t=1}^{n} \frac{X(1-T)}{(1+k)^t} + \sum_{t=1}^{n} \frac{TD}{(1+r)^t} \tag{1.1}$$

If all prices increased by h%, the value of the firm would be

$$V = \sum_{t=1}^{n} \frac{X(1-T)(1+h)^t}{[(1+k)(1+h)]^t} + \sum_{t=1}^{n} \frac{TD}{[(1+r)(1+h)]^t} \tag{1.2}$$

The real earnings of the firm would be unaffected by inflation, but the value of the firm would fall, because the nominal tax-deductibility of depreciation would have to be discounted at a higher nominal risk-free rate.

If the earnings of the firm inflated by h_i%, peculiar to its sector of the economy, while the general price index inflated at h%, where $h_i \neq h$, then the value of the firm would be given by:

$$V = \sum_{t=1}^{n} \frac{X(1-T)(1+h_i)^t}{[(1+k)(1+h)]^t} + \sum_{t=1}^{n} \frac{TD}{[(1+r)(1+h)]^t} \tag{1.3}$$

Since h_i and h are uncertain and cannot be fully anticipated, the real earnings of the firm becomes increasingly risky in the presence of high relative price dispersion and the real cost of capital of the firm will have to be increased to account for the increased risk in earnings. This would cause the firm value to fall.

Reduced risk through diversification has been the oft-repeated motive for conglomerate mergers by firm management. If two firms merge, the variability of their joint cash flows after the merger will be less than the sum of the variability of the cash flows of the separate firms before the merger took place. Weston and Mansinghka (22) empirically tested the effects of diversification by comparing operating profitability characteristics of two groups of conglomerate firms and single-industry firms, in 1958 and again in 1968, after the conglomerates had undertaken growth through taking part in a large number of mergers. They found that though the return on assets of conglomerates were less than that of non-conglomerates in 1958, the return on assets in 1968 for the two groups could not be distinguished from each other. Since the conglomerates primarily operated in industries such as aerospace in the fifties, and since these industries were depressed in that period, the conclusion of their study was that conglomerates had been able to achieve a defensive diversification.

An increase in high relative price dispersion should increase the total risk in the conglomerate firm's real earnings less than the increase in the single-industry firm's real earnings, if the two firms are the same size. If the stockholder were unable to achieve this diversification for himself, due to differential transactions costs and indivisibilities, i.e. if the capital market were not perfect, then the diversification offered by conglomerate firms would be valued by the stockholder, and the conglomerate firm's stock would be less adversely affected than the single-industry firm's stock by the advent of a high relative price dispersion.

Evidence that the capital market is far from perfect is offered by Blume and Friend's (4) analysis of two sets of survey data. The first, which was a 1971 survey on Federal individual income tax returns, asked the subject to list all dividend-paying stocks. It was found that 34.1% of the subjects held one stock, while 50.9% held no more than two stocks. The second survey, which was the Federal Reserve Board's survey of the financial characteristics of consumers, calculated the total number of stocks, both dividend-paying and non-dividend paying, held by the household. The median number of stocks held was 2 and the average number held was 3.41.

Complications enter into the analysis, however, since conglomerate companies are typically larger than single-industry firms. The conglomerate also differs from the single-industry firm in the size of earnings, amount of debt and interest expense and these should be taken into account.

The study consists of the following steps:

1) Measure relative price dispersion over the period February 1947 through August 1982.
2) Separate the period January 1970 through August 1982 into periods of high and low relative price dispersion.
3) Show that the risk of real inflation rates in individual product sectors increased significantly in periods of high relative price dispersion.
4) Analytically evaluate the relationship between the riskiness of real earnings of firms and relative price dispersion.
5) Show empirically that periods of high relative price dispersion accompany periods of high inflation.
6) Collect a sample of companies that may justifiably be labeled 'diversified conglomerates'.
7) Collect a sample of companies that may be called single-industry firms.
8) Determine if the change in total risk of real earnings, change in mean stock return and change in total risk of stock return

with increase in relative price dispersion differed significantly between the two groups of conglomerates and single-industry firms.

Following this introduction, Chapter II describes the methodology and results of steps 1 through 5 described in the preceding paragraph. Chapter III analyzes theoretically the differential effect of a high relative price dispersion on the single-product and multi-product firm. Chapter IV describes the methodology and results of the empirical tests that compare the effect of a high relative price dispersion on the two groups of companies. Chapter V summarizes and discusses the results.

CHAPTER II
RELATIVE PRICE DISPERSION AND RISK

Introduction

This chapter contains the following:

1) Measurement of relative price dispersion over 1947 through 1982.
2) Separation of the overall period 1970 through 1982 into periods of high and low relative price dispersion.
3) Demonstration that periods of high relative price dispersion are characterized by higher risk in individual product sectors.
4) Deduction that the risk of real earnings of firms would increase in periods of high relative price dispersion.
5) Empirical demonstration of a positive relationship between high relative price dispersion and inflation.

Measurement of Relative Price Dispersion

Relative price dispersion was calculated for each month of the period February 1947 through August 1982 as:

$$V(h_i)_t = \frac{1}{16} \sum_{i=1}^{17} (h_{it} - \overline{h}_{it})^2 \qquad (2.1)$$

where h_{it} stands for the inflation rate in the price index of the ith commodity at time t and $\overline{h}_{it}$ stands for the mean of the inflation rates in the prices of the 17 commodities represented by each component of the producer price index by selected commodity grouping shown in Table 2.1.

Determination of Periods of High and Low Relative Price Dispersion

The period 1970 through 1982 was focused upon as the period of interest since it was more recent. Three hypotheses were tested using a χ^2 test.

1) $H_0 : V(h_i) = 0.0025\%$

2) $H_0 : V(h_i) = 1\%$

3) $H_0 : V(h_i) = 2.25\%$

All the observations on $V(h_i)$ were significantly greater than 0.0025% and significantly less than 2.25%, both at the 95% and 99% confidence level. Some observations on $V(h_i)$ were significantly less than 1% and some were significantly greater than 1%. A definite pattern of low and high relative price dispersion emerged when the second hypothesis was tested. This was used to initially split up the overall period 1970 through 1982 and designate the periods as periods of high and low relative price dispersion as follows:

Period 1	January 1970 through November 1972	Low relative price dispersion
Period 2	December 1972 through December 1974	High relative price dispersion
Period 3	January 1975 through February 1979	Low relative price dispersion
Period 4	March 1979 through February 1981	High relative price dispersion

Hereafter, these periods will be referred to as period 1, period 2, period 3 and period 4 respectively.

Table 2.1

The Different Components of the Producer Price Index by Selected Commodity Grouping

1) Farm Products
2) Processed Foods and Feeds
3) Textile Products and Apparel
4) Hides, skins, leather and related products
5) Fuels and related products and power
6) Crude petroleum
7) Chemicals and allied products
8) Rubber and plastic products
9) Lumber and lumber products
10) Pulp, paper and allied products
11) Metals and metal products
12) Machinery and equipment
13) Furniture and household durables
14) Nonmetallic mineral products
15) Motor vehicles and equipment
16) Photographic equipment and supplies
17) Miscellaneous products

Data from the U. S. Department of Labor, Bureau of Labor Statistics, Producer Price Index.

The runs test was used to verify that the distributions of observations on $V(h_i)$ from periods 1 and 2, 2 and 3, and 3 and 4 could be distinguished from each other. Suppose that periods 1 and 2 were being compared. The observations on $V(h_i)$ in period 1 may be represented by 1's and those in period 2 by 2's. The runs test sorts the observations $V(h_i)_t$ from both periods in ascending order to obtain a pattern that may resemble the following situations:

Situation 1 1 1 1 1 1 1 1 1 2 2 2 2 .2
Situation 2 2 2 2 2 2 2 2 1 1 1 1 1 1
Situation 3 1 2 2 1 1 2 2 1 2 2 1 1 2 1 2

In situations 1 and 2 the number of runs (a run is a maximal subsequence of like elements) is small whereas in situation 3 the number of runs is large. From situations 1 and 2 the conclusion is that the observations of $V(h_i)_t$ for the 2 periods do not come from the same distribution, but this conclusion cannot be arrived at if the result looks like situation 3. If n_1 and n_2 are the total number of observations on $V(h_i)$ for periods 1 and 2 respectively, then the number of runs R under the null hypothesis of no difference between the distributions, has a normal distribution with mean E(R) and variance V(R), if n_1 and n_2 are large i.e., > 10, where

$$E(R) = \frac{2n_1n_2}{n_1+n_2} + 1 \tag{2.2}$$

$$V(R) = \frac{2n_1n_2}{(n_1+n_2)^2} \cdot \frac{(2n_1n_2-n_1-n_2)}{(n_1+n_2-1)} \tag{2.3}$$

and the z test may be used to test the null hypothesis of no difference between the distributions of $V(h_i)$ between periods 1 and 2, 1 and 3, 1 and 4, 2 and 3, 2 and 4 and 3 and 4.

Table 2.2 shows the results of the runs test. The z values are significant in the following comparisons:

Periods 1 and 2

Periods 1 and 4

Periods 2 and 3

Periods 3 and 4

The periods of high relative price dispersion can be distinguished from the periods of low relative price dispersion, but the periods of low relative price dispersion cannot be distinguished from each other and the periods of high relative price dispersion cannot be distinguished from each other, on the basis of the $V(h_i)$.

Risk in Individual Product Sectors

The variance of real inflation rates in individual product sectors may be shown to have increased in periods of high relative price dispersion. If h_i is the inflation rate in the ith product sector and h the inflation rate in the general price index, the variance of real inflation rates in individual product sectors is $V(\frac{1+h_i}{1+h})$. This was calculated for periods 1 through 4 for the 17 product sectors represented by each component of the producer price index. If σ_1^2 is the variance of real inflation rates in the ith product sector in period 1 and σ_2^2 the same quantity for period 2, the statistic $F = \frac{\sigma_1^2}{\sigma_2^2}$ may be used to test the null hypothesis of no difference in the variance of real inflation rates in the product sector in the two periods. Table 2.3 shows the results when the variances of the inflation rates for the

Table 2.2

Runs Test to Differentiate Between Periods of High and Low Differential Inflation

Periods Being Compared	Number of Observations on $V(h_i)$ in Period 1 n_1	Period 2 n_2	Actual Number of Runs R	Expected Number of Runs E(R)	Variance of Number of Runs V(R)	Test Statistic z
1970 January - 1972 November & 1972 December - 1974 December	35	25	10	30.17	13.92	-5.04*
1970 January - 1972 November & 1975 January - 1979 February	35	50	42	42.18	19.69	-0.04*
1970 January - 1972 November & 1979 March - 1981 February	35	24	16	29.48	13.49	-3.67*
1972 December - 1974 December & 1975 January - 1979 February	25	50	14	34.33	14.57	-5.33*

Table 2.2 - continued

Periods Being Compared	Number of Observations on $V(h_i)$ in Period 1 n_1	Number of Observations on $V(h_i)$ in Period 2 n_2	Actual Number of Runs R	Expected Number of Runs E(R)	Variance of Number of Runs V(R)	Test Statistic z
1972 December - 1974 December & 1979 March - 1981 February	25	24	27	25.49	11.99	0.44
1974 January - 1979 February & 1979 March - 1981 February	50	24	22	33.43	13.97	-3.06*

*indicates significance at the 95% confidence interval.

Table 2.3

Comparison of the Variance of Real Inflation Rates $[(\frac{1+h_i/100}{1+h/100})-1]*100$ in the Different Sectors Represented by the Components of the Producer Price Index, Between Periods of High and Low Relative Price Dispersion, Where h_i = Inflation Rate in Sector i and h is the Inflation Rate in the General Price Index

Sector i	Variance of $[(\frac{1+h_i/100}{1+h/100})-1]^{*100}$ in Period 1	Period 2	Period 3	Period 4	F Value When Variances are Compared for Periods 2 and 1	2 and 3	4 and 3
1	1.79	5.10	2.14	2.38	8.12	5.68	1.24*
2	0.34	1.77	0.61	0.58	27.10	8.42	0.90*
3	1.12	1.90	1.14	2.49	2.88	2.78	4.77
4	0.83	2.60	0.83	1.53	9.81	9.81	3.40
5	0.45	2.15	0.65	0.88	22.83	10.94	1.83
6	0.34	1.82	0.57	0.83	28.65	10.20	2.12
7	0.56	1.93	0.61	0.80	11.88	10.01	1.72
8	0.34	1.67	0.54	0.49	24.13	9.56	0.82*
9	0.32	1.61	0.51	0.53	25.31	9.97	1.08*
10	0.64	1.63	0.71	0.75	6.49	5.27	1.12*
11	0.43	2.13	0.69	6.32	24.54	9.53	83.89
12	0.48	1.83	1.02	2.03	14.54	3.22	3.96
13	1.51	5.06	2.09	4.35	11.23	5.86	4.33
14	0.49	1.85	0.67	0.57	14.25	7.62	0.72*
15	1.47	3.60	1.70	2.09	6.00	4.48	1.51*
16	1.01	1.85	1.12	1.76	3.36	2.73	2.47
17	0.52	2.54	1.01	1.30	23.86	6.32	1.66

*indicates not significant at the 95% confidence level.

individual product sectors are compared for periods 2 and 1, 2 and 3 and 4 and 3. For all sectors, the variance of real inflation rates was significantly larger for period 2 than for periods 1 and 3, and was significantly larger for period 4 than for period 3, for 10 out of 17 product sectors. The conclusion is that the variance of real inflation rates increased with high relative price dispersion. This empirical result will be used to show that the variance of the real earnings of the firm increased with high relative price dispersion.

Impact Upon Individual Firm Risk

Let X be the earnings of a firm at period 1. If in period 2, the firm's revenue inflates at h_i and the general price index inflates at h, where $h_i \neq h$, the variance of the real earnings of the firm is:

$$V(X \frac{(1+h_i)}{(1+h)}) = V(Xy) \tag{2.4}$$

where

$$y = \frac{1+h_i}{1+h} \tag{2.5}$$

Assuming X is independent of h_i and h,

$$\begin{aligned} V(Xy) &= E(Xy)^2 - (E(Xy))^2 \\ &= E(X^2y^2) - E(X^2)E(y^2) \\ &= [E(X^2) - (E(X))^2][E(y^2) - (E(y))^2] \\ &+ E(X^2)(E(y))^2 + E(y^2)(E(X))^2 \\ &- 2\ E(X^2)E(y^2) \end{aligned}$$

Table 2.4

$\frac{\partial(E(y))^2}{\partial V(y)}$ Where $y = \frac{1+h_i}{1+h}$, h_i = Inflation Rate in i^{th} Product Sector and h = Inflation Rate in the General Price Index

Sector i	$\frac{\partial(E(y))^2}{\partial V(y)}$		
	Period 1 and 2	Period 2 and 3	Period 3 and 4
1	0.00	0.01	1.76
2	0.29	0.33	-2.65
3	2.19	2.32	0.10
4	0.75	0.66	4.32
5	0.23	0.23	0.00
6	0.00	0.01	-0.03
7	0.03	0.02	0.49
8	0.08	0.10	-0.40
9	0.24	0.28	7.43
10	0.13	0.09	-0.83
11	0.29	0.35	0.04
12	0.20	0.32	0.00
13	0.54	0.62	4.20
14	-0.02	0.01	-0.11
15	0.30	0.25	1.55
16	0.50	0.58	0.02
17	0.05	0.03	0.58

$$= V(X)V(y) + (E(X))^2 \cdot V(y) + (E(y))^2 \cdot V(X) \tag{2.6}$$

$$\frac{\delta V(Xy)}{\delta V(y)} = [V(X) + (E(X))^2] + V(X) \frac{\delta (E(y))^2}{\delta V(y)} \tag{2.7}$$

Table 2.4 shows the values of $\frac{\delta(E(y))^2}{\delta V(y)}$ between periods 1 and 2, 2 and 3 and 3 and 4. These are positive for the most part.

Therefore, the right-hand side of equation 2.7 is positive. This implies that the real earnings of firms have increased risk in periods of high relative price dispersion.

Relative Price Dispersion and Inflation

Figure 2.1 shows the variation of relative price dispersion, represented by $\sqrt{V(h_i)}$ and the inflation rate in the general price index over time. Relative price dispersion appears to be positively related to inflation. The figure was based on annual values of both relative price dispersion and the inflation rate.

Two regressions were performed, which related relative price dispersion to the inflation rate. They were:

$$V(h_i) = a + bh \tag{2.8}$$

$$V(h_i) = a + b|h| \tag{2.9}$$

Equation 2.8 predicts a positive relationship between relative price dispersion and inflation. Equation 2.9 predicts a positive relationship between relative price dispersion and the absolute value of inflation. Whenever inflation or deflation deviates from normal values, imperfect

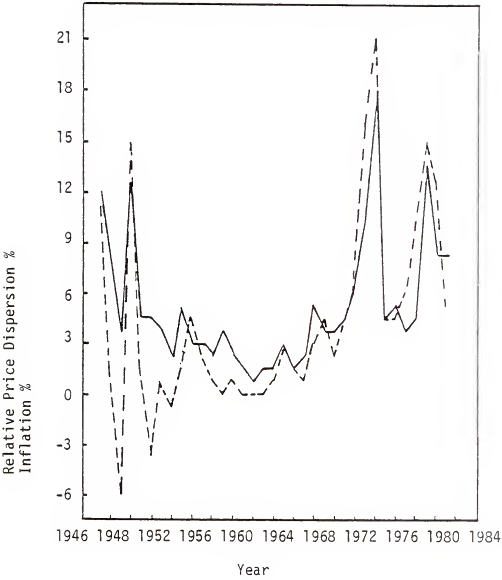

Figure 2.1

Plot of Annual Inflation Rate h
and Relative Price Dispersion $\sqrt{V(h_i)}$
Over 1947-1981 Against Time
--- Annual Inflation Rate
—— Relative Price Dispersion

information on the part of suppliers as to prices important to them, could cause an imperfect transmission of the inflation rate to different sectors of the economy, causing high relative price dispersion.

Tables 2.5 and 2.6 show the results of the regressions 2.8 and 2.9 respectively. The R^2 values are slightly improved when $|h|$ is the independent variable. Tables 2.7 and 2.8 show the results when $V(\frac{1+h_i}{1+h})$ is regressed on h and $|h|$ respectively. The R^2 values are improved when $|h|$ is the independent variable. Figure 2.2 shows that there is a positive relationship between relative price dispersion and the absolute value of inflation.

This relationship is important. The studies of Nelson (17), Bodie (7), and Fama and Schwert (9) established that real stock returns were negatively correlated with inflation. High relative price dispersion accompanies high inflationary periods and causes increased riskiness of firm earnings. This could cause the investor to discount the firm's real earnings at higher discount rates and thereby lead to the poor performance of the stock market in high inflationary periods.

Conclusion

The period 1970 through 1982 was separated into periods of high and low relative price dispersion. It was shown that a period of high relative price dispersion would cause an increased riskiness in the real earnings of firms. It was shown that high relative price dispersion accompanies high inflationary periods.

Table 2.5

Regression of Relative Price Variance $V(h_i)$ on the General Inflation Rate h, where h is Calculated from the Producer Price Index

$$V(h_i) = a + bh$$

Period	Number of Observations	Intercept (t)	Slope (t)	R^2
February 1947 - August 1982	427	0.73* (3.83)	2.57* (11.25)	0.23
January 1961 - August 1982	260	0.29 (0.96)	3.57* (10.27)	0.29

*indicates significance of the 95% confidence interval.

Table 2.6

Regression of Relative Price Variance $V(h_i)$ on the Absolute Value of the General Inflation Rate $|h|$, Where h is Calculated from the Producer Price Index

$$V(h_i) = a + b|h|$$

Period	Number of Observations	Intercept (t)	Slope (t)	R^2
February 1947 - August 1982	427	-0.49* (-2.28)	3.78* (14.53)	0.33
January 1961 - August 1982	260	-0.73* (-2.23)	4.57* (12.27)	0.37

*indicates significance at the 95% confidence interval.

Table 2.7

Regression of Variance of Real Inflation in the Different Sectors of the Economy on the General Inflation Rate Calculated from the Producer Price Index

$$V\left(\frac{1+h_i/100}{1+h/100}\right) = a + bh$$

Period	Number of Observations	Intercept (t)	Slope (t)	R^2
February 1947 - August 1982	427	7.70x10^{-5}* (4.26)	0.00024* (10.88)	0.22
January 1961 - August 1982	260	3.78x10^{-5} (1.30)	0.00033* (9.91)	0.28

*indicates significance at the 95% confidence interval.

Table 2.8

Regression of Variance of Real Inflation in the Different Sectors of the Economy on the Absolute Value of the General Inflation Rate Calculated from the Producer Price Index

$$V\left(\frac{1+h_i/100}{1+h/100}\right) = a + b|h|$$

Period	Number of Observations	Intercept (t)	Slope (t)	R^2
February 1947 - August 1982	426	-3.72×10^{-5} (-1.81)	0.00035* (14.20)	0.32
January 1961 - August 1982	260	-5.76×10^{-5} (-1.84)	0.00042* (11.90)	0.36

*indicates significance at the 95% confidence interval.

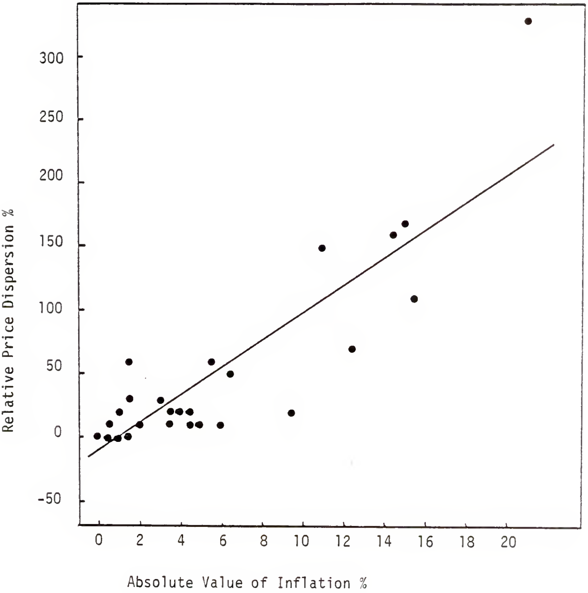

Figure 2.2

Plot of Actual and Predicted Annual Relative Price Dispersion $V(h_i)$ From the Regression

Relative Price Dispersion = $b_0 + b_1$(Absolute Value of Inflation) The Straight Line Represents the Predicted Values and the Data Points the Actual Values of Relative Price Dispersion

CHAPTER III
A THEORETICAL ANALYSIS OF THE EFFECT OF DIFFERENTIAL INFLATION ON THE SINGLE-PRODUCT AND MULTI-PRODUCT FIRM

Introduction

This chapter theoretically examines the effect of a high relative price dispersion on a single-product firm and a multi-product firm. The market value of the firm is obtained by discounting the expected dividends of the firm by the firm's cost of capital. High relative price dispersion may be expected to affect the firm's market value by its impact on the firm's expected earnings and on the firm's cost of capital. Van Horne and Glassmire (20) have shown that if prices of goods sold by the firm lag wages and other costs, the market value of the firm falls, while if prices, wages and other costs change exactly in keeping with the unanticipated change in inflation, share value is unaffected. This analysis was applied to a single firm. The analysis is to be extended to a multi-product firm so as to arrive at a comparison of the differential effect of a high relative price dispersion on the single-product and the multi-product firm.

The effect of price uncertainty on the firm's output decision as addressed by previous authors is briefly reviewed in this introduction before proceeding to the analysis.

The firm operating under certainty would produce that quantity of output at which its profits were maximized. If π is the profit of the firm, then

$$\pi = pq - c(q) \tag{3.1}$$

where

p = price of output

q = quantity produced

c = cost of production which depends on the quantity produced q.

Maximizing profits with respect to the quantity produced leads to the relation:

$$\frac{\partial \pi}{\partial q} = p - c'(q) = 0$$

$$p = c'(q) \tag{3.2}$$

Therefore, the profit maximizing quantity produced would be that at which price p = marginal cost $c'(q)$ for the perfectly competitive firm.

Leland (13) showed that with the introduction of uncertainty in the firm's output price, the firm's decision making would be changed to that of maximizing expected utility of profits. If the firm's utility function is denoted by $U(\pi)$, the problem transforms to:

$$\text{Maximize } EU(\pi)$$

$$\text{with respect to } q \tag{3.3}$$

where

$\pi = pq - c(q)$ = profits of the firm

$U(\pi)$ = the firm's utility function

E denotes the expectations operator.

The conditions for a maximum are:

$$E(\frac{\partial\pi}{\partial q} \cdot U'(\pi) = 0 \tag{3.4}$$

$$E(\frac{\partial^2\pi}{\partial q^2} \cdot U'(\pi) + (\frac{\partial\pi}{\partial q})^2 \cdot U''(\pi)) < 0 \tag{3.5}$$

Leland showed analytically that the effect of increased uncertainty in the price of the risk-averse firm's output is a decrease in its quantity produced, below the profit maximizing quantity under certainty.

Bradburd (8) and Blair and Heggestad (3) demonstrated that conglomeration will not be behaviorially neutral. Consider a single-product firm and a multi-product firm, one of whose subsidiaries is identically situated to the single-product firm in the same product market. Further, a change in the output of any given subsidiary has no direct effect on any other subsidiary's profits and the management of the single-product firm and the conglomerate subsidiary are equally risk averse. Maximizing the certainty equivalent of profit with respect to quantity produced for both the single-product firm and the conglomerate, Bradburd showed that the optimum output level of the conglomerate subsidiary would be greater than that of the single-product firm, if the particular subsidiary's profits were negatively correlated with the combined profits of the conglomerate's other subsidiaries, and less than that of the single-product firm, if this correlation were positive. Bradburd's analysis obtained the result for a general utility function restricted to possess a risk aversion independent of wealth, while Blair and Heggestad considered the special case of exponential utility.

Holthausen (12) showed that the existence of futures markets and forward contracts which enable the firm to hedge the price of its output by selling a portion in advance would cause the output produced by the firm to depend only on the forward price and would, in particular, be independent of the firm's degree of risk aversion, and the probability distribution of the uncertain price. If the forward price were less than the expected future price, the firm would hedge some, but not all, of its output; it would hedge more, the more risk averse it was. The existence of a forward market would cause the firm to produce more than it would under uncertainty.

Some of the simplifying assumptions made in these papers were that the only uncertainty was in the price of the firm's output, that quantity demanded equalled quantity supplied and quantity supplied equalled quantity produced, so that there was no inventory problem to deal with. These assumptions will be adhered to. In addition, it shall be assumed that neither the single-product firm nor the multi-product firm hedge the price of their output or the costs of their input in the forward or futures market. The following sections consider the effect of conglomeration on profits and returns on assets under the assumption that the prices of outputs and inputs are uncertain and analyze the effects of a high unanticipated differential inflation or high relative price dispersion on the profits and return on assets of a single product and a multi-product firm.

Uncertainty and the Output Decisions of Single-Product and Multi-Product Firms

Consider a single product firm 1 which produces one output which shall be referred to as A and uses one input. Its profit π_1 is given by:

$$\pi_1 = p_1 q_1 - c_1 q_1 \tag{3.6}$$

where

p_1 = price of output

q_1 = quantity of output produced = quantity of output demanded

c_1 = cost of input per unit of output

The assumption made here is that there are no economies of scale in production and that the firms' horizon is large enough that considerations of fixed cost may be dispensed with. The firm's utility function is $U(\pi_1)$ and its measure of risk aversion is given by α where $\alpha = -\frac{U''(\pi_1)}{U'(\pi_1)} \cdot \frac{1}{2}$ and is assumed to be constant over the wealth interval of interest. The firm arrives at its output decision by maximizing the certainty equivalent of profits which is equivalent to maximizing expected utility if 1) the absolute risk aversion is constant over the relevant range of wealth, 2) end-of-period wealth is equal to certain and constant initial wealth plus uncertain profits and 3) the distribution of uncertain outcomes is normal, as shown by Lintner (14). The firm's certainty equivalent of profit π_1^* is given by:

$$\pi_1^* = E(\pi_1) - \alpha\ V(\pi_1) \tag{3.7}$$

where

$E(\pi_1)$ = expected profit

$V(\pi_1)$ = variance of profit.

Maximizing π_1^* with respect to the quantity produced, the first and second order conditions for a maximum are:

$$\frac{\partial \pi_1^*}{\partial q_1} = \frac{\partial E(\pi_1)}{\partial q_1} - \alpha \frac{\partial V(\pi_1)}{\partial q_1} = 0 \tag{3.8}$$

$$\frac{\partial^2 \pi_1^*}{\partial q_1^2} = \frac{\partial^2 E(\pi_1)}{\partial q_1^2} - \alpha \frac{\partial^2 V(\pi_1)}{\partial q_1^2} < 0 \tag{3.9}$$

From 3.6

$$E(\pi_1) = E(p_1 - c_1) \cdot q_1 \tag{3.10}$$

$$V(\pi_1) = q_1^2 V(p_1) + q_1^2 V(c_1) - 2q_1^2 \text{ cov}(p_1, c_1) \tag{3.11}$$

Using equations 3.8, 3.10 and 3.11

$$\frac{\partial \pi_1^*}{\partial q_1} = E(p_1 - c_1) - \alpha[2q_1 V(p_1) + 2q_1 V(c_1) - 4q_1 \text{ cov}(p_1, c_1)] = 0$$

$$q_1 = \frac{E(p_1 - c_1)}{2\alpha(V(p_1) + V(c_1) - 4 \text{ cov}(p_1, c_1))} \tag{3.12}$$

Using equations 3.9, 3.10 and 3.11

$$\frac{\partial^2 \pi_1^*}{\partial q_1^{\,2}} = \alpha 2(V(p_1) + V(c_1) - 2 \text{ cov}(p_1, c_1)) < 0 \tag{3.13}$$

unless $V(p_1) = V(c_1) = \text{cov}(p_1, c_1)$, i.e., the second order condition for the existence of a maximum will be fulfilled unless the variability of the input and output prices are equal and the correlation between them = 1. Examining equation 3.12 and contrasting it with the case of perfect certainty in price p_1 and cost c_1 per unit, it is noted that under perfect certainty if $p_1 > c_1$, an infinite amount will be produced but if $p_1 < c_1$ then the quantity produced would be 0. Under the conditions that p_1 and c_1 are uncertain, an interim solution between the 2 extremes would exist (under the assumption of no economies of scale) which would satisfy 3.12.

If there existed a second specialized firm 2 which produced an output different from A, which shall be referred to as B, then if the profits of firm 2, which is assumed to be the same size as firm 1, and has the same constant risk aversion $\alpha = -\frac{U''(\pi_2)}{U'(\pi_2)} \cdot \frac{1}{2}$, is given by:

$$\pi_2 = (p_2 - c_2)\, q_2 \tag{3.14}$$

where

p_2 = price per unit of output B

c_2 = cost of input per unit of output B

q_2 = quantity of output produced by firm 2 = quantity of output demanded.

By maximizing the certainty equivalent of profit as before, the firm's output decision is given by:

$$q_2 = \frac{E(p_2 - c_2)}{2\alpha V(p_2 - c_2)} \tag{3.15}$$

Now, consider a multi-product firm which has two subsidiaries. The first subsidiary produces output A and the second subsidiary produces output B. It is assumed that the multi-product firm is of the same size as the two specialized firms 1 and 2 referred to earlier. The measure of risk aversion of the multi-product firm is given by $\alpha = -\frac{1}{2}\frac{U''(\pi_c)}{U'(\pi_c)}$ = that of the single-product firms 1 and 2, where $U(\pi_c)$ = utility function of the multi-product firm. The multi-product firm's profit π_c is given by:

$$\pi_c = p_1 q_{c_1} - c_1 q_{c_1} + p_2 q_{c_2} - c_2 q_{c_2} \tag{3.16}$$

where

p_1 = price of output A, which is produced by the first subsidiary and the specialized firm 1

q_{c_1} = quantity of output A produced by the multi-product firm

c_1 = cost of input per unit of output A produced

p_2 = price of output B, which is produced by the second subsidiary and firm 2

q_{c_2} = quantity of output B produced

c_2 = cost of input per unit of output B.

The multi-product firm sets its output decision in period 1 by maximizing its certainty equivalent of profit $\pi_c{}^*$, where:

$$\pi_c{}^* = E(\pi_c) - \alpha V(\pi_c) \tag{3.17}$$

The problem is:

Maximize $\pi_c{}^*$

with respect to q_{c_1} and q_{c_2}

Using 3.16 and 3.17:

$$\begin{aligned}\pi_c{}^* = {} & q_{c_1} E(p_1 - c_1) + q_{c_2} E(p_2 - c_2) \\ & - \alpha[q_{c_1}{}^2 V(p_1 - c_1) + q_{c_2}{}^2 V(p_2 - c_2) \\ & - 2\, q_{c_1} q_{c_2} \operatorname{cov}(p_1 - c_1,\ p_2 - c_2)]\end{aligned} \tag{3.18}$$

Maximizing $\pi_c{}^*$ with respect to q_{c_1} and q_{c_2} yields the following first and second order conditions:

$$\frac{\partial \pi_c{}^*}{\partial q_{c_1}} = E(p_1 - c_1) - \alpha[2q_{c_1} V(p_1 - c_1) + 2q_{c_2} \operatorname{cov}(p_1 - c_1, p_2 - c_2)] \tag{3.19}$$

$$\frac{\partial \pi_c^*}{\partial q_{c_2}} = E(p_2-c_2) - \alpha[2q_{c_2} V(p_2-c_2) + 2q_{c_1} \operatorname{cov}(p_1-c_1,p_2-c_2)] \tag{3.20}$$

$$\frac{\partial^2 \pi_c^*}{\partial q_{c_1}^2} = -2\,\alpha\, V(p_1-c_1) < 0 \tag{3.21}$$

$$\frac{\partial^2 \pi_c^*}{\partial q_{c_2}^2} = -2\,\alpha\, V(p_2-c_2) < 0 \tag{3.22}$$

From equation 3.19

$$q_{c_1} = \frac{E(p_1-c_1) - 2\,\alpha q_{c_2} \operatorname{cov}(p_1-c_1,p_2-c_2)}{2\,\alpha\, V(p_1-c_1)}$$

i.e.,

$$q_{c_1} = q_1 - q_{c_2} \frac{\operatorname{cov}(p_1-c_1,p_2-c_2)}{V(p_1-c_1)} \tag{3.23}$$

Similarly,

$$q_{c_2} = q_2 - q_{c_1} \frac{\operatorname{cov}(p_1-c_1,p_2-c_2)}{V(p_2-c_2)} \tag{3.24}$$

Comparing equations 3.12 and 3.23 the quantity of output A produced by the first subsidiary of the multi-product firm q_c will be less than the quantity of output A produced by the specialized firm 1 q_1, if the correlation between the revenue per unit of the two subsidiaries is positive and vice versa if the correlation is negative. This was to be expected since the size of the multi-product firm and the specialized firm are equal, but since subsidiary 1 is smaller than specialized firm 1, it is understandable that the subsidiary would produce less than the specialized firm. The same reasoning applies to the quantities of output B produced by subsidiary 2 and specialized firm 2.

Assuming that:

$$E(p_1-c_1) = E(p_2-c_2) \tag{3.25}$$

$$V(p_1-c_1) = V(p_2-c_2) \tag{3.26}$$

yields the following conclusions:

$$q_1 = q_2 \tag{3.27}$$

$$q_{c_1} = q_{c_2} = \frac{q_1}{1+\rho} \tag{3.28}$$

$$q_{c_1} + q_{c_2} = \frac{2q_1}{1+\rho} \tag{3.29}$$

Equation 3.29 describes the relationship between the quantity produced by the multi-product firm and that produced by the specialized firm 1 under the simplifying assumptions described by equations 3.25 and 3.26. If $\rho = 1$, the quantity produced by the multi-product firm is given by:

$$q_{c_1} + q_{c_2} = q_1 \tag{3.30}$$

and the output produced by the two firms are equal. If $\rho = 0$,

$$q_{c_1} + q_{c_2} = 2q_1 \tag{3.31}$$

and the quantity produced by the multi-product firm will be twice as much as that produced by the specialized firm. If $\rho = -1$, then the quantity produced by the multi-product firm will be ∞. Although strictly speaking 2 different outputs A and B cannot be added together to determine the relative production of the conglomerate and single-product firm, the result 3.29 may be interpreted as follows: Consider a single-product firm C whose size = w_1 x size of single-product firm 1. Assume that the size of subsidiary 1 = w_1 x size of multi-product firm = w_1 x size of specialized firm 1. Then equation 3.29 says that the quantity of output A q_{c_1} produced by subsidiary 1 will be greater than the quantity of output produced by firm C which would equal w_1 x quantity of output produced by specialized firm 1, i.e., $q_{c_1} > w_1 \times q_1$.

Profits of the Multi-Product Firm and Specialized Firm Under Uncertainty

The expected profit and variability of profit of the multi-product firm and the conglomerate are compared in this section. As given by equation 3.6, the profit of the single-product firm is:

$$\pi_1 = p_1 q_1 - c_1 q_1 \qquad (3.6)$$

and the profit of the multi-product firm as given by equation 3.16 is:

$$\pi_{c_1} = p_1 q_{c_1} - c_1 q_{c_1} + p_2 q_{c_2} - c_2 q_{c_2} \qquad (3.16)$$

and from equations 3.10, 3.11

$$E(\pi_1) = q_1 E(p_1 - c_1) \qquad (3.10)$$

$$V(\pi_1) = q_1{}^2 V(p_1 - c_1) \qquad (3.11)$$

From (3.16):

$$E(\pi_c) = q_{c_1} E(p_1 - c_1) + q_{c_2} E(p_2 - c_2) \qquad (3.32)$$

$$V(\pi_c) = q_{c_1}{}^2V(p_1-c_1) + q_{c_2}{}^2V(p_2-c_2)$$

$$+ 2q_{c_1}q_{c_2}\ \mathrm{cov}(p_1-c_1,\ p_2-c_2) \qquad (3.33)$$

Assuming, that the conditions described in equations 3.25 and 3.26 hold, from 3.31:

$$E(\pi_c) = \frac{2}{1+\rho} E(\pi_1) \qquad (3.34)$$

$$V(\pi_c) = \left(\frac{2q_{c_1}}{q_1}\right)^2 \cdot \left[\frac{1+\rho}{2}\right] q_1{}^2 \cdot V(p_1-c_1) \qquad (3.35)$$

$$V(\pi_c) = \left(\frac{2q_1}{1+\rho}\right)^2 \left(\frac{1+\rho}{2}\right) V(p_1-c_1) \qquad (3.36)$$

$$V(\pi_c) = \left(\frac{2}{1+\rho}\right)^2 \left(\frac{1+\rho}{2}\right) V(\pi_1) \qquad (3.37)$$

$$V(\pi_c) = \frac{2}{1+\rho} \cdot V(\pi_1) \qquad (3.38)$$

If $\rho = 1$,

$$E(\pi_c) = E(\pi_1) \qquad (3.39)$$

$$V(\pi_c) = V(\pi_1) \qquad (3.40)$$

If $\rho = 0$,

$$E(\pi_c) = 2\ E(\pi_1) \qquad (3.41)$$

$$V(\pi_c) = 2\ V(\pi_1) \qquad (3.42)$$

If $\rho = -1$,

$$E(\pi_c) = \infty \tag{3.43}$$

$$V(\pi_c) = 0 \tag{3.44}$$

If $0 < \rho < 1$,

$$E(\pi_c) = \frac{2}{1+\rho} \cdot E(\pi_1) > E(\pi_1) \tag{3.45}$$

$$V(\pi_c) = (\frac{2}{1+\rho})^2 (\frac{1+\rho}{2})\ V(\pi_1) > V(\pi_1) \tag{3.46}$$

From a scan of 3.35 and 3.46, it is noted that $V(\pi_c)$ differs from $V(\pi_1)$ due to 2 effects which shall be referred to as an indirect effect of diversification and a direct effect of diversification. The magnitude of the indirect effect is represented by $(\frac{2q_{c_1}}{q_1})^2$ and its existence is caused by $2q_{c_1}$ differing from q_1. In fact, $2q_{c_1} > q_1$ as may be noted from 3.29 if $0 < \rho < 1$ and $q_{c_1} = q_{c_2}$. The conglomerate or multi-product firm produces a total output which is greater than the total output of the specialized firm, since diversification allows the conglomerate's risk-return ratio to be less than that of the specialized firm. Since $(\frac{2q_{c_1}}{q_1})^2 > 1$, if $0 < \rho < 1$, the indirect effect of diversification causes the expected earnings and standard deviation of earnings of the multi-product firm to be greater than the corresponding quantities of the specialized firm. The direct effect of diversification is to reduce the variability of earnings of the multi-product firm below that of the specialized firm while leaving expected earnings unchanged from its value for the specialized firm and its effect is represented by the factor $\frac{1+\rho}{2}$ which is < 1. The direct effect of diversification reduces the variability of earnings of the multi-product firm below that of the conglomerate firm, but it is dominated by the indirect effect and therefore if $0 < \rho < 1$, the variability of earnings of the multi-product firm will be greater than that of the single-product firm.

Return on Assets of the Multi-Product Firm and the Specialized Firm Under Uncertainty

The effect of conglomeration on the return on assets may now be considered. If r is the return on assets of a firm, then r is given by:

$$r = \frac{\pi - (\pi - D - D_p)T}{V} \qquad (3.47)$$

where

r = return on assets

π = earnings

D = debt

D_p = depreciation

T = tax rate

V = total assets.

If the specialized firm 1 and the multi-product firm do not differ in the amount of debt and depreciation and their total assets are equal, then differences in their return on assets arise only due to differences in their earnings. The relationship between expected earnings and variability of earnings of the multi-product firm and the specialized firm described by equations 3.39 through 3.46, under the assumptions of 3.25 and 3.26 and under the different assumptions for the value of ρ, hold for the relationship between the expected return on assets and the variability of return on assets of the multi-product firm and the specialized firm. Let r_1 and r_c represent the return on assets of the specialized firm 1 and the multi-product firm.

If $\rho = 1$,

$$E(r_c) = E(r_1) \tag{3.48}$$

$$V(r_c) = V(r_1) \tag{3.49}$$

If $\rho = 0$,

$$E(r_c) = 2\,E(r_1) \tag{3.50}$$

$$V(r_c) = 2\,V(r_1) \tag{3.51}$$

If $\rho = -1$,

$$E(r_c) = \infty \tag{3.52}$$

$$V(r_c) = 0 \tag{3.53}$$

If $0 < \rho < 1$,

$$E(r_c) = \frac{2}{1+\rho}\,E(r_1) \tag{3.54}$$

$$V(r_c) = \frac{2}{1+\rho}\,V(r_1) \tag{3.55}$$

Except when $\rho = -1$, the risk-return tradeoff of the multi-product firm and the specialized firm are equal. A risk-free asset is introduced into the analysis at this point, to determine if a portfolio of the risk-free asset plus the multi-product firm's assets dominate a portfolio of the risk-free asset plus the specialized firm's assets by the mean-variance rule. This will hold, if:

$$\frac{E(r_c)-r_f}{V(r_c)} > \frac{E(r_1)-r_f}{V(r_1)} \qquad (3.56)$$

where

r_f = risk-free interest rate.

For the general case, with ρ taking on any value different from -1, 3.56 becomes:

$$\frac{\frac{2}{1+\rho} \cdot E(r_1)-r_f}{\frac{2}{1+\rho} V(r_1)} > \frac{E(r_1)-r_f}{V(r_1)}$$

$$-\left(\frac{1+\rho}{2}\right) > -1 \qquad (3.57)$$

If $0 < \rho < 1$, 3.57 will hold. Therefore, a portfolio of the multi-product firm and the risk-free asset will dominate the portfolio of the specialized firm and the risk-free asset.

If the indirect effect of diversification discussed in the previous section did not exist:

$$E(r_c) = E(r_1) \qquad (3.58)$$

$$V(r_c) = \frac{1+\rho}{2} \cdot V(r_1) \qquad (3.59)$$

and the multi-product firm dominates the specialized firm in terms of the return-risk tradeoff by the mean-variance rule if $0 < \rho < 1$. If $\rho = -1$, the multi-product firm dominates the specialized firm by the mean-variance rule.

Differential Effect of High Relative Price Dispersion on the Multi-Product and Single-Product Firm

Chapter II established

1) The different inflation rates across different product sectors at any one time are widely dispersed.
2) The variability of inflation rates in individual product sectors are higher in the high relative price dispersion periods than in the low relative price dispersion periods.

It is assumed that in period 2, a period of high relative price dispersion sets in and that the product sectors of specialized firms 1 and 2 are affected as follows:

$$dE(p_1-c_1) = dE(p_2-c_2) \tag{3.60}$$

$$dV(p_1-c_1) = dV(p_2-c_2) > 0 \tag{3.61}$$

If $V(p_1-c_1)$ and $V(p_2-c_2)$ larger than their values in a period of low relative price dispersion, then even if

$$dV(p_1-c_1) = dV(p_2-c_2)$$

the probability that both sectors will inflate by the same inflation rate will be small if $\rho \neq 1$. It is assumed that the correlation between the two product sectors A and B remains unchanged between the two periods of low and high relative price dispersion. It is assumed that when the period of high relative price dispersion sets in, the firms were unable to change the output decisions made in period 1, and the effect of a high relative price dispersion on the earnings of the multi-product and specialized firm are analyzed. Assume that in period 1, equations 3.25 and 3.26 held, so that equations 3.27 and 3.28 also held in period 1.

From 3.10, 3.11, 3.30, 3.33, 3.60 and 3.61,

$$dE(\pi_1) = q_1 dE(p_1 - c_1) \tag{3.62}$$

$$dV(\pi_1) = q_1^2\ dV(p_1 - c_1) \tag{3.63}$$

$$dE(\pi_c) = (\frac{2}{1+\rho}) \cdot q_1 dE(p_1 - c_1) = \frac{2}{1+\rho}\ dE(\pi_1) \tag{3.64}$$

$$dV(\pi_c) = (\frac{2}{1+\rho})^2 \cdot (\frac{1+\rho}{2})\ q_1{}^2\ dV(p_1 - c_1) \tag{3.65}$$

$$dV(\pi_c) = \frac{2}{1+\rho}\ dV(\pi_1) \tag{3.66}$$

If $\rho = 1$,

$$dE(\pi_c) = dE(\pi_1) \tag{3.67}$$

$$dV(\pi_c) = dV(\pi_1) \tag{3.68}$$

If $\rho = 0$,

$$dE(\pi_c) = 2\ dE(\pi_1) \tag{3.69}$$

$$dV(\pi_c) = 2\ dV(\pi_1) \tag{3.70}$$

If $\rho = -1$,

$$dE(\pi_c) = \infty \tag{3.71}$$

$$dV(\pi_c) = 0 \tag{3.72}$$

If $0 < \rho < 1$,

$$dE(\pi_c) > dE(\pi_1) \tag{3.73}$$

$$dV(\pi_c) > dV(\pi_1) \tag{3.74}$$

If conglomeration were behaviorally neutral and the multi-product firm produced a total output which equalled that of the single-product firm, then high relative price dispersion would cause the expected earnings of the conglomerate to change by the same amount as that of the specialized firm but the variability of earnings of the conglomerate will increase by less than the variability of earnings of the specialized firm.

The effect of high relative price dispersion on the return on assets of the multi-product and specialized firm would be similar to the effect on earnings, under the assumption of equal size, debt and depreciation of the two firms. If the assumptions 3.25, 3.26, 3.60 and 3.61 are relaxed, then the only assertion that may be made is that, whether differential inflation affects a conglomerate adversely or not when compared to a specialized firm depends on the product sectors that the conglomerate is involved in, how these fare in periods of high relative price dispersion and the degree of involvement of the conglomerate in adversely affected product sectors versus product sectors that benefited from high differential inflation.

Effect of Differences in Size and Debt upon Earnings, Probability of Bankruptcy and Return on Multi-Product and Single-Product Firms

The preceding sections assumed that the multi-product firm and the specialized firm were characterized by the same size and amount of debt and depreciation.

Suppose A and B are two companies which make the same product and differ only in size. The profits of A are x and those of B kx, where $k > 1$. The expected value and variability of earnings of A are $E(x)$ and $V(x)$ and those of B are $kE(x)$ and $k^2V(x)$ respectively. Suppose that high relative price dispersion sets in causing:

$$dV(x) > 0 \tag{3.75}$$

Then the increase in the variability of earnings of firm B:

$$dV(kx) = k^2\, dV(x) \tag{3.76}$$

and this increase in variability of earnings of the bigger firm B would be greater than the increase in variability of the smaller firm A.

The probability of bankruptcy is defined as the probability that the firm will fail to meet its fixed obligations such as interest expense.

$$\text{Probability of bankruptcy} = P(\text{Earnings} < \text{Interest Expense}) \tag{3.77}$$

For firm A

$$P(\text{Bankruptcy}) = P(x < I_A) \tag{3.78}$$

where

x = earnings of A

I_A = interest expense of A.

For firm B,

$$P(\text{Bankruptcy}) = P(kx < I_B) \tag{3.79}$$

where

kx = earnings of B

I_B = interest expense of B.

If the interest expense of B is k x interest expense of A, then 3.78 and 3.79 reduce to:

$$\text{P(Bankruptcy) of A} = P\left(\frac{x-E(x)}{\sqrt{V(x)}} < \frac{I_A-E(x)}{\sqrt{V(x)}}\right) \tag{3.80}$$

$$\text{P(Bankruptcy) of B} = P\left(\frac{k}{k}\left(\frac{x-E(x)}{\sqrt{V(x)}}\right) < \frac{kI_A-kE(x)}{\sqrt{V(x)}}\right)$$

$$= P\left(\frac{x-E(x)}{\sqrt{V(x)}} < \frac{I_A-E(x)}{\sqrt{V(x)}}\right) \tag{3.81}$$

The market return characteristics: the mean return, total risk of return and systematic risk of return would be influenced by the amount of debt in the firm's capital structure. The higher the amount of debt in the firm's capital structure, the greater the cost of its equity and the lower the market value of its stock and therefore the lower the mean return of the firm. The higher the amount of debt in the firm's capital structure, the greater the probability of default and the greater the risk to the stockholder. The higher the amount of debt in the firm's capital structure, the higher the systematic risk of the firm (see Hamada (11)).

In general, conglomerates are large firms characterized by large amounts of debt in their capital structure and this makes the analysis of the effect of high relative price dispersion upon these firms no longer simple.

Conclusion

The effect of relative price dispersion upon the earnings of multiproduct and single-product firms and the conditions under which multiproduct firms would be less adversely affected than single product firms were laid down. An empirical analysis follows in the next chapter.

CHAPTER IV
AN EMPIRICAL ANALYSIS OF THE EFFECT OF DIFFERENTIAL INFLATION ON SPECIALIZED AND CONGLOMERATE FIRMS

Introduction

This chapter presents the methodology and results of empirical tests that examined the effect of a high relative price dispersion on the firm. As demonstrated in Chapter II, the effect of a high relative price dispersion would be to increase the riskiness of real earnings. A conglomerate may be relatively insulated from this increase in risk. This may result in conglomerates outperforming specialized companies in return in periods of high relative price dispersion. Empirical tests were performed to compare the effect of high relative price dispersion on conglomerates and specialized firms.

Hypotheses to be Tested

The null hypotheses to be tested may be classified into those involving the operating profitability of the conglomerate and specialized companies and those involving the market performance characteristics.

The objective of the empirical tests was to compare the effects of a high relative price dispersion on diversified conglomerates versus the undiversified single-industry firm. Chapter II established that the riskiness of real earnings of all firms would increase in a period of high relative price dispersion. The first hypothesis to be tested was that the diversification ability of the conglomerate caused the increase in the variability of its real earnings to be less than that of specialized companies. The ratio of the variability of the real earnings σ_1^2 of a conglomerate company to the variability of the real earnings σ_2^2 of a specialized company would be lower in a period of high relative price dispersion than its value in a preceding period of low relative price dispersion. The second null hypothesis therefore states that the ratio of the variability of real earnings of a conglomerate to the variability of real earnings of a specialized company remained unchanged between two periods of high and low relative price dispersion. The third null hypothesis to be investigated was whether the probability of bankruptcy for conglomerates and specialized companies differed from each other in the different periods of high and low relative price dispersion. If a conglomerate was relatively insulated when compared to a specialized company from the increase in variability of real earnings that accompanies high relative price dispersion, then the probability of bankruptcy of conglomerate companies should have been less than that of specialized companies in a period of high relative price dispersion.

Proceeding to the hypotheses involving the market return characteristics: A period of high relative price dispersion focuses greater importance on the diversification ability of the investor. If the investor were unable to invest in a large number of different assets owing to differential transaction costs and indivisibilities, then an investment medium or company that allowed him to achieve this diversification would possess a higher value to him than the stock of a specialized company. Therefore, in a period of high relative price dispersion conglomerate stocks would outperform specialized company stocks in their market return characteristics. What was investigated here was: if the changes in mean return $\overline{R}$, total risk σ^2 and systematic risk β of conglomerate companies and specialized companies between succeeding periods of low and high relative price dispersion or vice versa differed significantly.

Identification of a Sample of Conglomerate Firms

Webster's twentieth century dictionary of the English language (21) defines the word 'conglomerate' as 'a collection, mixture or mass of many things', but some more precise definition of a conglomerate was needed for purposes of comparison of the performance of these companies with the single-industry companies. The Federal Trade Commission (FTC) (19) classifies all mergers undertaken by companies into

(1) horizontal mergers which involve firms which produce one or more of the same or closely related products in the same geographic market

(2) vertical mergers which represent firms at different levels of the production process in the same industry i.e., the two companies had a potential buyer/seller relationship prior to the merger.

(3) conglomerate mergers are all other remaining mergers but these may be further classified into product extension, market extension and other.

A product extension merger involves two companies who are functionally related in production and/or distribution but sell products that do not directly compete with each other. A market extension merger involves two companies which manufacture the same products but sell them in different geographic markets. Other mergers involve the consolidation of two essentially unrelated companies.

Previous empirical studies, such as the Weston and Mansinghka (22) study were also concerned with defining a conglomerate. The criteria used by the Weston and Mansinghka study was to select all firms which took part in three or more mergers during the period of interest and in which 20% or more of the increase in total assets of the firm were accounted for by external acquisitions. Since the concern in this study was to identify the extent to which the diversification achieved by conglomerates has insulated these firms against the decrease in real return and increase in risk that accompanies a high relative price dispersion, the motivation was to identify a sample of diversified conglomerates.

The FTC's Statistical report (19) was used to obtain an initial list of all those companies that took part in three or more conglomerate mergers over the period 1947-1969. The term 'conglomerate' used here embraces the product extension, market extension and other type of conglomerate merger as defined by the FTC. An attempt was made to obtain a list of companies that had only taken part in the 'pure' conglomerate mergers that involved unrelated companies, but most of these companies had also taken part in the product extension or market extension type of conglomerate merger. A limitation of the FTC report on mergers is it only reports mergers which involved the exchange of assets of $10 million or more and mergers of smaller size were unreported.

The diversification achieved by each company in the initial list was computed using an index called the Herfindahl Summary of Industrial concentration. The Herfindahl index has more popularly been used as a measure of the degree of concentration or the degree of competition within an industry. It was applied in this study to compute the degree of diversification within the firm. It shall be referred to hereafter as the index of diversification.

An index of diversification should not only consider the number of separate industries that a firm is involved in, but also consider the magnitude of its involvement in each separate industry. For instance, a firm's activities may be classified into ten different industries but if 99% of its sales contribution is from a single industry, the firm may hardly be said to be diversified. Then again, a firm may be involved in just four industries, but if the proportion of the sales contribution of each of the industries is equal, the firm may be viewed as diversified. The index of diversification used here is defined as $\sum_{i=1}^{n} (\frac{S_i}{S})^2$, where S_i is the sales from the i^{th} industry that the firm is involved in and S is the total sales of the firm. Suppose that each industry of the firm contributes an equal proportion to the overall sales of the firm. Then the value of the index of diversification = $\sum_{i=1}^{n} (\frac{1}{n}\frac{S}{S})^2 = \frac{1}{n}$ and the higher the value of n, i.e., the larger the number of industries that the firm is involved in, the smaller the index of diversification. Suppose firm 1 is involved in two industries and that 99% of its sales is from one industry and the remaining 1% is from the second industry. The value of the index of diversification for the firm is = $(\frac{99}{100})^2 + (\frac{1}{100})^2 = 0.9801$. Consider firm 2 which is again involved in the same two industries, but 50% of its sales contribution comes from each of the two industries. The index of diversification for the firm is $(\frac{50}{100})^2 + (\frac{50}{100})^2 = 0.50$. Therefore, the higher the degree of diversification of the firm, as measured by the number of its separate unrelated industries and the proportion of the sales contribution from each industry, the lower the index of diversification.

This index has previously been used by Berry (2) in his study of market structure. In his study, the proportion of sales in each industry was approximated by the number of employees in the plants of that particular industry. In this study, Moody's Industrial Manual for 1970 and available annual reports of the companies on the initial list obtained from the FTC's list of mergers, were used to determine the proportion of sales from the different industries that the companies were involved in, at the end of 1969.

There are limitations in calculating the index of diversification for these companies. The proportion of sales in each separate standard industrial classification code is unavailable either at the 4 digit, 3 digit or 2 digit level. Instead, the descriptions used by the companies to classify total sales from each sector in their annual reports was followed. This definition, of course, suffers from the deficiency that such a classification need not be uniform across all firms in the initial sample. Several companies used broad or imprecise definitions such as 'Consumer products' or 'Industrial products' that were difficult to interpret. These deficiencies aside, the index of diversification was calculated for each company in the initial sample for 1969. Table 4.1 lists all the companies in the initial sample along with their calculated index of diversification, which varied from 0.11 to 0.73.

To obtain a final sample of conglomerates from this list, all companies with an index of diversification greater than 0.50 were removed. All companies which had taken part in any type of merger over the period 1970 through 1979 were eliminated from the final list. This was done because the period 1970 through 1981 encompasses the periods of high and low relative price dispersion over which the performance of conglomerates

Table 4.1

Initial Sample of Conglomerate Companies

No.	Name	Industries	Percentage of Sales	Index of Diversification
1.	American Tobacco	1) Tobacco Products	80.3	0.67
		2) Distilled Beverages	5.1	
		3) Food Products	13.3	
		4) Other	1.9	
2.	American Can Co.	1) Packaging	68.0	0.49
		2) Consumer Industries	13.0	
		3) Service Industries	8.0	
		4) Chemical	6.0	
		5) Printing	5.0	
3.	Bangor Punta Corporation	1) Leisure	23.0	0.17
		2) Process Engineering	11.0	
		3) Fashion Fabrics	22.0	
		4) Transportation	0.0	
		5) Public Security	8.0	
		6) Energy Systems	18.0	
		7) Agribusiness	14.0	
		8) Professional	4.0	
4.	Bendix Corporation	1) Missiles	4.0	0.21
		2) Space	12.0	
		3) Aviation	31.0	
		4) Oceanics	2.0	
		5) Automotive	27.0	
		6) Automation-Scientific	12.0	
		7) Electronics	4.0	
		8) Other	8.0	
5.	Boise Cascade Corporation	1) Building Materials	21.0	0.24
		2) Construction	32.0	
		3) Recreational Vehicles	12.0	
		4) Paper Products	26.0	
		5) Investment, Utility and Other	9.0	

Table 4.1-continued

No.	Name	Industries	Percentage of Sales	Index of Diversification
6.	Borg Warner Corporation	1) Automotive Equipment	36.0	0.23
		2) Industrial and Steel Products	30.0	
		3) Air Conditioning and Building Products	20.0	
		4) Chemicals and Plastics	14.0	
7.	Burlington Industries	1) Apparel	69.0	0.55
		2) Home Furnishings	26.0	
		3) Industrial Fabrics	5.0	
8.	Combustion Engineering	1) Energy Generating Equipment	42.0	0.25
		2) Industrial Plant Const.	18.0	
		3) Refractories	12.0	
		4) Oil and Natural Gas	8.0	
		5) Industrial Fabrics	5.0	
		6) Industrial Equipment	15.0	
9.	Continental Can/Continental Group	1) Metal	51.9	0.35
		2) Paper	20.5	
		3) Plastics	10.0	
		4) International	17.6	
10.	Diamond International Corporation	1) Lumber and Retail	25.0	0.24
		2) Packaging	37.0	
		3) Pulp, Paper and Paperboard	12.0	
		4) Consumer Products	13.0	
		5) Machinery	3.0	
		6) Foreign	4.0	
		7) Commercial Printing, Advertising, Other	6.0	
11.	Dresser Industries	1) Petroleum Group	36.0	0.21
		2) Machinery and Transportation	26.0	
		3) Refractories and Minerals	21.0	
		4) Industrial Specialties	17.0	

Table 4.1-continued

No.	Name	Industries	Percentage of Sales	Index of Diversification
12.	Eagle Picher Industries	1) Chemicals and Minerals	18.0	0.17
		2) Electronics and precision	14.0	
		3) Fabricated Metal Products	20.0	
		4) Machinery, Equipment and Buildings	16.0	
		5) Plastics and Coatings	13.0	
		6) Rubber and Allied Products	19.0	
13.	Eaton Manufacturing Company	1) Truck and Off-Highway Components	32.0	0.55
		2) Materials Handling and Construction Equipment	25.0	
		3) Control Systems and General Products	17.0	
		4) Passenger Car Products	20.0	
		5) Lock and Builder's Hardware	6.0	
14.	El Paso Natural Gas	1) Natural Gas	66.0	0.54
		2) Chemical and Manufactured Products	33.0	
		3) Other	1.0	
15.	General Dynamics	1) Aerospace	76.0	0.58
		2) Marine Group	11.0	
		3) Resources	6.0	
		4) Asbestos	2.0	
		5) Computer i-o Systems	1.0	
		6) Telephone Exchange Equipment	5.0	
16.	Genesco	1) Apparel	52.0	0.40
		2) Footwear	31.0	
		3) Materials and Components	17.0	
17.	General Mills	1) Food Products	84.4	0.73
		2) Specialty Chemicals	4.3	
		3) Crafts, Games and Toys	10.4	
		4) New Ventures	4.9	

Table 4.1-continued

No.	Name	Industries	Percentage of Sales	Index of Diversification
18.	GTE	1) Telephone	45.0	0.33
		2) Electric	29.0	
		3) Telecommunications	18.0	
		4) International	10.0	
		5) Intercompany Eliminations	-2.0	
19.	Georgia Pacific	1) Plywood	37.0	0.40
		2) Pulp and Paper	29.0	
		3) Lumber	16.0	
		4) Gypsum	6.0	
		5) Chemicals and Minerals	12.0	
20.	Glen Alden Corporation	1) Distilled Whiskey and Spirits	51.0	0.35
		2) Consumer Products	25.6	
		3) Building Materials and Supplies	10.6	
		4) Other	12.8	
21.	W. R. Grace	1) Chemicals	37.0	0.25
		2) Agricultural Chemicals and Products	19.0	
		3) Consumer Foods and Services	25.6	
		4) Petroleum and Extractive Industries	4.0	
		5) Steamship Operations	5.0	
		6) Other	9.0	
22.	IT&T	1) Telecommunication	19.0	0.13
		2) Industrial and Consumer Products	28.0	
		3) Natural Resources	5.0	
		4) Defense and Space	5.0	
		5) Consumer and Business Services (11 distinct categories)	39.0	
		6) Utility Operations	4.0	

Table 4.1-continued

No.	Name	Industries	Percentage of Sales	Index of Diversification
23.	Ingersoll Rand	1) Construction and Mining	18.0	
		2) Durable Goods	26.0	
		3) Non-durable Goods	6.0	
		4) Petroleum, Chemical and Process Industries	19.0	0.16
		5) Service Industries, Repair and Maintenance	14.0	
		6) Utilities	12.0	
		7) Aerospace, Ordinance and Government Agencies	4.0	
		8) Other	1.0	
24.	Walter Kidde	1) Safety and Security	36.0	
		2) Industrial and Technological	22.0	0.20
		3) Commercial and Consumer	28.0	
		4) Transportation	14.0	
25.	LTV	1) Meat	31.0	
		2) Steel	26.0	
		3) Aerospace	17.0	
		4) Airlines	8.0	0.21
		5) Electro-Systems	5.0	
		6) Wire and Cable	5.0	
		7) Sound Systems	4.0	
		8) Sporting Goods	3.0	
		9) Pharmaceuticals and Chemicals	1.0	
26.	Litton Industries	1) Business Systems and Equipment	27.0	
		2) Defense and Marine	26.0	0.26
		3) Industrial Systems and Equipment	30.0	
		4) Professional Service and Equipment	17.0	
27.	Mead Corporation	1) Paper	65.0	
		2) Metals	20.0	0.48
		3) Educational	11.0	
		4) Interior Furnishings	4.0	

Table 4.1-continued

No.	Name	Industries	Percentage of Sales	Index of Diversification
28.	National Industries	1) Consumer Products	58.0	0.39
		2) Retailing	10.0	
		3) Industrial Products	18.0	
		4) Energy Products	11.0	
		5) Services	3.0	
29.	Occidental Petroleum	1) Oil and Gas	60.0	0.46
		2) Industrial Chemical	30.0	
		3) Coal	9.0	
		4) Other	1.0	
30.	Pennwalt	1) Chemicals	49.0	0.37
		2) Equipment	27.0	
		3) Health	24.0	
31.	Pfizer	1) Chemicals	46.0	0.24
		2) Agricultural Products	24.0	
		3) Consumer Products	24.0	
		4) Chemicals and Materials Science Products	18.0	
		5) Pharmaceutical	12.0	
32.	Rockwell	1) Automotive	21.0	0.16
		2) Aricraft and Missiles	14.0	
		3) Space Systems	20.0	
		4) Electronics and Electromechanical	21.0	
		5) Textiles and Related Machinery	4.0	
		6) Rocket Engines	7.0	
		7) Components for Industrial Equipment	5.0	
		8) Graphic Arts	6.0	
		9) Nuclear, Marine and Other	4.0	
33.	SCM Corporation	1) Business and Office	20.0	0.18
		2) Consumer Products	38.0	
		3) Industrial	40.0	
		4) Military/Government	2.0	
34.	Signal Cos.	1) Oil and Gas	31.0	0.33
		2) Aerospace and Industries	34.0	
		3) Truck Manufacture	35.0	

Table 4.1-continued

No.	Name	Industries	Percentage of Sales	Index of Diversification
35.	Singer Co.	1) Sewing Machines	30.6	0.20
		2) Other Consumer Products	14.7	
		3) Metering and Control Equipment	9.7	
		4) Industrial Sewing and Textile Machinery	7.0	
		5) Heating and Air Conditioning	2.4	
		6) Other Industrial	1.7	
		7) Office Products and Furniture	6.6	
		8) Systems and Data Communication	5.1	
		9) Other Office Products	1.1	
		10) Navigation and Guidance Systems	7.6	
		11) Other Defense and Space Products	5.7	
		12) Training Systems	4.7	
		13) Other Educational and Training Systems	3.1	
36.	Studebaker-Worthington	1) Electrical Products	23.0	0.14
		2) Automotive	17.0	
		3) Consumer and Consumer Products	11.0	
		4) Turbines	10.0	
		5) Pumps	9.0	
		6) Compressors	8.0	
		7) Air Conditioning, Heating, and Refrigeration	8.0	
		8) Other	15.0	
37.	TRW Inc.	1) Electronic Systems and Computer Software	29.0	0.26
		2) Vehicle Components	28.0	
		3) Aerospace Components, Systems and Service	23.0	
		4) Industrial Components, Systems and Equipment	20.0	
38.	Teledyne	1) Electronics and Control	40.0	0.34
		2) Aviation and Industrial	30.0	
		3) Materials Technology	30.0	
		4) Geophysics and Oceanography	---	

Table 4.1-continued

No.	Name	Industries	Percentage of Sales	Index of Diversification
39.	Tenneco Inc.	1) Machinery, Equipment, Ship-building	35.0	0.31
		2) Gas Sales and Transportation	23.0	
		3) Refined Products	10.0	
		4) Crude Oil and Condensate	6.0	
		5) Chemicals	10.0	
		6) Packaging	10.0	
		7) Land Use and Other	5.0	
40.	Textron Inc.	1) Aerospace	37.0	0.27
		2) Industrial	21.0	
		3) Metal	16.0	
		4) Consumer	26.0	
41.	U. S. Industries	1) Health and Leisure	6.0	0.19
		2) Services	6.0	
		3) Shelter and Furnishings	11.0	
		4) Plastics and Petroleum	8.0	
		5) Apparel and Accessories	27.0	
		6) Industrial and Agribusiness	22.0	
		7) Building Materials and Construction	20.0	
42.	Westinghouse Electric Corporation	1) Power Systems	30.0	0.24
		2) Consumer Products	18.0	
		3) Industry	31.0	
		4) Defense	14.0	
		5) Broadcasting, Leisure and Leisure Time	5.0	
		6) Other	2.0	
43.	Whittaker Corporation	1) Aerospace Materials and Structures	10.0	0.18
		2) Industrial Structures	10.0	
		3) Industrial Polychem	15.0	
		4) Marine and Leisure Time	7.0	
		5) Architectural Products	12.0	
		6) Industrial and Commercial Metals	30.0	
		7) Technical Products	16.0	

Table 4.1-continued

No.	Name	Industries	Percentage of Sales	Index of Diversification
44.	Gulf & Western	1) Theatrical Rentals	12.0	0.11
		2) TV Production and Rentals	3.0	
		3) Industrial	17.0	
		4) Systems	10.0	
		5) Precision Engineering	5.0	
		6) Metals Forming	10.0	
		7) Food	5.0	
		8) Consumer Products	10.0	
		9) Forest and Paper Products	12.0	
		10) Metals and Chemicals	7.0	
		11) Distribution	8.0	
		12) Realty	1.0	
45.	IC Industries	1) Manufacturing	42.0	0.38
		2) Transportation	44.0	
		3) Real Estate	3.0	
		4) Consumer Products	11.0	
46.	Martin Marietta	1) Cement and Lime	12.0	0.33
		2) Chemicals	11.0	
		3) Rock Products	7.0	
		4) Aluminum	19.0	
		5) Aerospace	51.0	

and specialized companies were to be compared. The eliminations had to be restricted to the companies that took part in mergers up to 1979, since the FTC data on mergers is currently available only through 1979. This left a final list of 23 conglomerates.

A final sample was obtained by eliminating companies that took part in any type of merger over 1970 through 1979. Companies such as LTV and IT&T which closed down, spun off or sold divisions were also eliminated. It may be remarked here, that owing to these precautions, the index of diversification, which was calculated for the conglomerate companies for 1970, would not have diverged widely over 1971 through 1981 from its value calculated for 1970. Differing price inflation in different sectors may conceivably have caused the index of diversification to vary over time, but this is of less concern, since the index of diversification was only employed to obtain a sample of conglomerates and not used in any statistical test.

Identification of a Sample of Specialized Firms

A control sample of companies involved in specialized industries was required. Since a requirement of the tests was that both earnings data and stock returns data be available for the companies used in the tests, an initial list of all companies for which stock returns data was available on the Center for Research in Security Prices monthly returns tape and earnings data was available on the Standard and Poors' Compustat Quarterly Industrial tape was prepared. A random number generator was used to select an initial sample of 120 companies from the list and Moody's Industrial Manual 1970 (16) was scanned to ensure that each company was involved in only one industry. Diversified companies and companies involved in more than one line of business were weeded out

Table 4.2

List of Conglomerates in the Final Sample

Number	Name
1.	Bangor Punta Corporation
2.	Boise Cascade Corporation
3.	Borg Warner Corporation
4.	Continental Group
5.	Diamond International Corporation
6.	Eagle-Picher Industries
7.	Genesco, Inc.
8.	Gulf & Western Inds Inc.
9.	Litton Inds Inc.
10.	Martin Marietta Corporation
11.	Mead Corporation
12.	National Industries
13.	Occidental Petroleum Corporation
14.	Rockwell International Corporation
15.	SCM Corporation
16.	Signal Cos.
17.	Singer Co.
18.	TRW Inc.
19.	Tenneco Inc.
20.	Textron Inc.
21.	U. S. Industries
22.	Westinghouse Electric Corporation
23.	Whittaker Corporation

from the list. In addition, all those companies which had taken part in any type of merger over 1970 through 1979 and in conglomerate mergers between 1947 and 1969 were removed from the list. This left a final sample of 28 companies. It was impossible to calculate the index of diversification for specialized companies since the data on percentage of sales by product category was unavailable for these companies. However, since descriptions of the company in Moody's Industrial Manual suggested that these companies were only involved in one industry, it may be assumed that the indices of diversification of the specialized companies were either 1 or close to 1. Table 4.3 lists the companies in the final specialized sample.

Data Collection

Quarterly figures on earnings, interest expense, total debt and total assets were obtained for each of these companies between 1970 January and 1981 February. Real earnings and interest expense were obtained for each of these companies for each of these quarters by discounting the corresponding nominal figures by the quarterly inflation rate computed from the consumer price index supplied by the U.S. Department of Labor, Bureau of Labor Statistics, Consumer Price Index. The mean of real earnings, the variability of real earnings and the mean of real interest expense were calculated for each of the following periods:

Period 1 1970 January - 1972 November
Period 2 1972 December - 1974 December
Period 3 1975 January - 1979 February
Period 4 1979 March - 1981 February

which may be recalled to have been established in Chapter II as consecutive periods of low, high, low and high relative price dispersion

Table 4.3

List of Specialized Companies in the Final Sample

Number	Name	Industry Code
1.	Allied Maintenance	7349
2.	Alpha Portland Industries	1600
3.	Amstar Corporation	2062
4.	Asarco Inc.	1000
5.	Bard (C.R.) Inc.	3841
6.	Boeing Co.	3721
7.	Cummins Engine	3510
8.	Echlin Mfg. Co.	3699
9.	Fisher Foods Inc.	5411
10.	High Voltage Engineering	3640
11.	International Flavors and Fragrances	2844
12.	Jorgensen (Earle M.) Co.	5050
13.	Kennametal Inc.	3540
14.	Lubrizol Corporation	2890
15.	Marshall Fields & Co.	5311
16.	McDermott Inc.	3443
17.	Mohasco Corporation	2510
18.	Owens-Corning Fiberglas Corp.	3290
19.	Pennzoil Corporation	2911
20.	Polaroid Corporation	3861
21.	Russ Togs Inc.	2300
22.	SCOA Inds Inc.	5331

Table 4.3-continued

Number	Name	Industry Code
23.	Scot Lad Foods	5140
24.	Seagram Co. Ltd.	2085
25.	Shell Oil Co.	2911
26.	Starrett (L.S.) Co.	3429
27.	Texas Oil & Gas Co.	4922
28.	Wean United Inc.	3540

respectively. Hereafter, the above periods of low, high, low and high relative price dispersion will be referred to as periods 1, 2, 3 and 4 respectively.

The market return parameters to be compared were the mean return of the company, the total riskiness of the stock or the variability of the stock return of the company and the systematic risk of the company. These parameters were calculated for each conglomerate company and specialized company in the sample for each of the 4 periods. The data used was the stock returns of these companies over the period 1970 through 1981, available on the Center for Research in Security Prices monthly returns tape. The formulae used were:

$$\text{Mean return } \overline{R} = \frac{1}{n} \sum_{i=1}^{n} R_i \qquad (4.1)$$

$$\text{Variance of return } \sigma^2 = \frac{1}{n-1} \sum_{i=1}^{n} (R_i-\overline{R})^2 \qquad (4.2)$$

where

R_i = return in month i

n = number of months in the period of interest.

The systematic risk β for each period was calculated by regressing the monthly returns in each period on the return on the market portfolio in a regression of the form:

$$R_t = a + b\, R_{mt} \qquad (4.3)$$

where

R_t = return on the company's stock in period t.

R_{mt} = return on the market portfolio in period t.

The return on the market portfolio was calculated as a weighted average of the monthly return on stock, bonds and real estate with the weights used being market value outstanding. The return on stocks was the value-weighted return of all stocks traded on the NYSE and the AMEX. The return on government bonds, corporate bonds and state and local bonds was obtained from Moody's Government bond index, corporate bond index and municipal bond index respectively. The return on real estate was obtained as the inflation rate in the median price of single family homes, as reported by the Bureau of the Census. The disadvantage of computing the return on real estate from the median price of single family homes was that, this price not only reflects the increase in prices of real estate, but also the trend in preferred sizes of single family homes. The market value of stock outstanding was obtained from the annual market value of stocks outstanding on the NYSE and the AMEX, obtained from the NYSE fact book (18) and the AMEX statistical review (1). The market value of government bonds, corporate bonds and state and local bonds was obtained from summing up the annual market value of these entities held by institutions and individuals, available in the Federal Reserve's Flow of Funds Accounts (5, 6). The market value of real estate outstanding was obtained by summing up the annual capital stock of residential, non-residential and farm real estate, obtained from the National Income and Product Accounts.

Results of Empirical Tests

The analysis-of-variance test and the Mann-Whitney U test were used to test the null hypotheses. Appendix A details the application of these tests to this study. The Mann-Whitney U test was used, since the assumption of normality required by the analysis-of-variance test may not have been satisfied.

Hypothesis I. This hypothesis states that the variability of real earnings of conglomerates increase by less than the variability of real earnings of specialized companies between a period of low and high relative price dispersion. The variability of real earnings of the two groups of companies, conglomerates and specialized, were calculated for periods 1 through 4. The change in variability of real earnings between periods 1 and 2, periods 2 and 3 and periods 3 and 4 were calculated. The parameter of interest in the analysis-of-variance test and Mann-Whitney U test was the change in variability of real earnings between two periods. Table 4.4 shows the results of the analysis-of-variance test and Table 4.5 the result of the Mann-Whitney U test. If V_1, V_2, V_3 and V_4 denote the variability of real earnings of the company, the parameters of interest were V_1-V_2, V_2-V_3 and V_3-V_4.

From Table 4.4 it is noted that the coefficient of the dummy variable in the regression equation A.1 employed in the analysis-of-variance test was not significant and the R^2 values were very low. From a look at Table 4.5, it is noted that the z values of equation A.5 were not significant. Both the analysis-of-variance test and the Mann-Whitney U test led to the same conclusion regarding the change in variability of real earnings of firms. Both conglomerates and specialized companies were affected equally in this parameter by high relative price dispersion.

Noting that the intercept term b_0 in equation A.1 also was not significant, as shown by the t values of the intercept term in Table 4.4 for two out of three comparisons--the conclusion was that the changes in variability of real earnings were for the most part random.

Hypothesis II. If the change in variability of real earnings of conglomerates between two periods of low and high relative price dispersion were less than the corresponding value for specialized companies,

Table 4.4

Comparison of the Change in Variability of Real Earnings of Specialized Companies and Conglomerate Companies Between 2 Periods of High and Low Relative Price Dispersion Using the Analysis of Variance Test.

Periods Being Compared/ Parameter	Intercept (t)	Slope (t)	F	R^2
1 and 2 $V_1 - V_2$	1499.86 (1.29)	-1769.51 (-1.12)	1.25	0.03
2 and 3 $V_2 - V_3$	-3290.54* (-1.70)	2413.78 (0.92)	0.84	0.02
3 and 4 $V_3 - V_4$	- 891.84 (-0.66)	- 595.91 (-0.32)	0.11	0.00

*indicates significance at the 95% confidence interval.

Table 4.5

Comparison of the Changes in Variability of Real Earnings Between Two Periods of High and Low Relative Price Dispersion for Conglomerate Companies and Specialized Companies Using the Mann-Whitney U Test

Periods Being Compared/ Parameter	U	E(U)	V(U)	$z=\frac{U-E(U)}{\sqrt{V(U)}}$
Period 1 and 2 $V_1 - V_2$	367	322	2790.67	0.85
Period 2 and 3 $V_2 - V_3$	341	322	2790.67	0.36
Period 3 and 4 $V_3 - V_4$	265	322	2790.67	-1.08

then if $\frac{\sigma_1^2}{\sigma_2^2}$ denoted the ratio of the variability of real earnings σ_1^2 of conglomerates to that σ_2^2 of specialized companies, then $\frac{\sigma_1^2}{\sigma_2^2}$ would have a value in a period of high relative price dispersion that was significantly less than its value in a period of low relative price dispersion. This was tested. The 23 conglomerate companies were randomly paired with 23 specialized companies out of the sample of 28 specialized companies, and the ratios $\frac{\sigma_1^2}{\sigma_2^2}$ were calculated for each of the 23 pairs for periods 1, 2, 3 and 4.

The parametric T test was used to test the null hypothesis that the mean of the ratios of $\frac{\sigma_1^2}{\sigma_2^2}$ for the periods being compared were equal. If μ_1 and μ_2 are the means of the ratios of $\frac{\sigma_1^2}{\sigma_2^2}$ for periods 1 and 2 and ν_1^2 and ν_2^2 are variances of the ratios of $\frac{\sigma_1^2}{\sigma_2^2}$ for periods 1 and 2, then the test statistic T is given by:

$$T = \frac{\mu_1 - \mu_2}{s(\frac{1}{n_1} + \frac{1}{n_2})^{\frac{1}{2}}} \qquad (4.4)$$

where s^2 the pooled variance is given by

$$s^2 = \frac{(n_1-1)\nu_1^2+(n_2-1)\nu_2^2}{n_1 + n_2 - 2} \qquad (4.5)$$

where n_1 and n_2 are the number of observations on $\frac{\sigma_1^2}{\sigma_2^2}$ for periods 1 and 2 respectively. Table 4.6 shows the values of μ_1 and μ_2, ν_1^2 and ν_2^2 for periods 1 through 4 and Table 4.7 shows the results of the parametric T test. If the T statistics calculated were greater than t_α with $n_1 + n_2 - 2$ degrees of freedom, the null hypothesis that the means of the ratios were equal for the periods being compared may be rejected. The value of the benchmark t with 40 degrees of freedom is 1.96 at the 95% confidence interval.

The data available on a single Compustat tape did not cover the period of interest 1970-1981 so earnings data was obtained from the older version of the tape for periods 1, 2 and 3 and from the newer version of the tape for periods 3 and 4. The T tests for the analysis of the difference between the ratios $\frac{\sigma_1^2}{\sigma_2^2}$ were done for periods 1, 2 and 3 and for periods 3 and 4 in separate runs of the same program. This would result in different random pairings of conglomerates and specialized companies in the two runs. The ratios $\frac{\sigma_1^2}{\sigma_2^2}$ for different periods in the same run may be compared but the ratios may not be compared if the values are obtained from two separate runs, since the pairings are different. Hence from Table 4.6 run 1 gives the ratios for the periods 1, 2 and 3 and run 2 the ratios for the periods 3 and 4. Results of run 1 may be used to calculate T values for comparison of periods 1, 2 and 3 and results of run 2 used to calculate T values for periods 3 and 4. Since the T values were not significant, the null hypothesis of no difference between the ratios $\frac{\sigma_1^2}{\sigma_2^2}$ between 2 periods of low and high relative price dispersion may not be rejected.

The test was repeated using the non-parametric Mann-Whitney U test. If σ_1^2 is the variability of real earnings of conglomerates and σ_2^2 the variability of real earnings of specialized companies, $(\frac{\sigma_1^2}{\sigma_2^2})_1$, $(\frac{\sigma_1^2}{\sigma_2^2})_2$, $(\frac{\sigma_1^2}{\sigma_2^2})_3$, and $(\frac{\sigma_1^2}{\sigma_2^2})_4$ denote these ratios for periods 1, 2, 3 and 4. The Mann-Whitney U test was then used to determine if $(\frac{\sigma_1^2}{\sigma_2^2})_1 = (\frac{\sigma_1^2}{\sigma_2^2})_2$, $(\frac{\sigma_1^2}{\sigma_2^2})_2 = (\frac{\sigma_1^2}{\sigma_2^2})_3$, and if $(\frac{\sigma_1^2}{\sigma_2^2})_3 = (\frac{\sigma_1^2}{\sigma_2^2})_4$. Noting from Table 4.8, that the z values of equation A.5 were not significant, the conclusion was that these ratios did not change significantly between periods of high and low relative price dispersion.

Table 4.6

Mean and Standard Deviation of the Ratios $\frac{\sigma_1^2}{\sigma_2^2}$,
Where σ_1^2 = Variability of Real Earnings of a
Conglomerate, and σ_2^2 = Variability of Real Earnings of
a Specialized Company, in the Periods of High and Low
Relative Price Dispersion

Period	Description	Mean	Standard Deviation
		of the ratio of variability of real earnings of conglomerates to that of specialised companies	
January 1970 - November 1972	Low relative price dispersion	2065.23	10,638.94
December 1972 - December 1974	High relative price dispersion	1022.18	2,912.82
January 1975 - February 1979	Low relative price dispersion	2278.94	5,073.39
January 1975 - February 1979	Low relative price dispersion	109.97	241.42
March 1979 - February 1981	High relative price dispersion	153.73	479.78

Table 4.7

Comparison of Mean of $\frac{\sigma_1^2}{\sigma_2^2}$, Where

σ_1^2 = Variability of Real Earnings of a Conglomerate
σ_2^2 = Variability of Real Earnings of a Specialized Company
Between Periods of High and Low Relative Price Dispersion

Periods Being Compared	Number of Observations Period 1 n_1	 Period 2 n_2	s^2	T
1 and 2	21	21	60,825,782.2	0.85
2 and 3	21	21	17,111,903.22	0.98
3 and 4	21	21	144,235.43	-0.37

Table 4.8

Comparison of the Ratios $\frac{\sigma_1^2}{\sigma_2^2}$ Where

σ_1^2 = Variability of Real Earnings of a Conglomerate

σ_2^2 = Variability of Real Earnings of a Specialized Company Between Periods of High and Low Relative Price Dispersion Using the Mann-Whitney U Test

Periods Being Compared/ Parameter	U	E(U)	V(U)	$z=\frac{U-E(U)}{\sqrt{V(U)}}$
Period 1 and 2 σ_1^2/σ_2^2	191	200	1366.67	-0.24
Period 2 and 3 σ_1^2/σ_2^2	198	200	1366.67	-0.05
Period 3 and 4 σ_1^2/σ_2^2	136	180.5	7039.5	0.53

The conclusion of the T test and the Mann-Whitney U test were that the variability of real earnings of conglomerates and specialized companies were affected equally by high relative price dispersion.

Hypothesis III. The null hypothesis to be tested states that the probability of bankruptcy was no different for the conglomerate and specialized companies in different periods of high and low relative price dispersion. If x is the real earnings and $\overline{I}$ the mean real interest expense of the company, the probability of bankruptcy may be stated as:

$$\text{Probability of bankruptcy} = P(x < \overline{I}) \tag{4.6}$$

A limitation of this definition is it does not reflect the ability of the large firm to draw upon capital when faced with a liquidity crisis. If E(x) and V(x) are the expected value and variance of real earnings of the company, then the probability of bankruptcy is given by:

$$P\left(\frac{x-E(x)}{\sqrt{V(x)}} < \frac{\overline{I}-E(x)}{\sqrt{V(x)}}\right) \tag{4.7}$$

$$= P(z < z_{\alpha}) \tag{4.8}$$

where

$$z = \frac{x-E(x)}{\sqrt{V(x)}} \tag{4.9}$$

$$z_{\alpha} = \frac{\overline{I}-E(x)}{\sqrt{V(x)}} \tag{4.10}$$

The lower the value of z_{α} the lower the probability of bankruptcy of the company. In comparing two companies, if the value of z_{α} for one company is less than the value of z_{α} for the other company, the conclusion is that the probability of bankruptcy for the first company is less than that for the second company.

The values of z_α were computed for conglomerate companies and specialized companies for periods 1 through 4. The analysis-of-variance test and the Mann-Whitney U test were then used to compare the values of z_α for periods 1 through 4 between conglomerates and specialized companies. Table 4.9 shows the results of the analysis-of-variance tests. The slope coefficients b_1 in equation A.1 were not significant for the first three periods considered. Table 4.10 shows the results of the Mann-Whitney U test. The z values of equation A.5 were not significant for the first three periods, as Table 4.10 shows. Both the analysis-of-variance test and the Mann-Whitney U test came to the same general conclusion with regard to period 4: the probability of bankruptcy of conglomerates differed from that of specialized companies. The analysis-of-variance test result for period 4 may be analyzed as follows: Using the regression equation A.1 and the results for the slope coefficient (-6.82) and the intercept coefficient (3.01) from Table 4.10 and recalling that the dummy variable D in equation A.1 had a value 0 for conglomerates and a value 1 for specialized companies, the following mean values of z_α for period 4 for the 2 groups were calculated.

Mean value of z_α for conglomerates = -6.82

Mean value of z_α for specialized companies = -6.82 + 3.01 * 1
= -3.81

Since the mean z_α for period 4 for conglomerates was less than that for specialized companies, the probability of bankruptcy of conglomerates was less that of specialized companies in period 4.

Hypothesis IV. This states that the change in mean return in a period of high relative price dispersion for a conglomerate

Table 4.9

Comparison of Values of z_α for Conglomerate and Specialized Companies, Where the Probability of Bankruptcy for a Company is Defined as: Probability of Bankruptcy = P(Earnings < Expected Interest Expense) and $z_\alpha = \frac{\text{Expected Interest Expense - Expected Earnings}}{(\text{Variability of Earnings})^{\frac{1}{2}}}$ Using the Analysis-of-Variance Test

Period	Intercept (t)	Slope (t)	F	R^2
1.	-3.15* (-5.24)	0.24 (0.29)	0.09	0.002
2.	-2.85* (-6.34)	-0.20 (-0.33)	0.11	0.002
3.	-2.49* (-5.86)	-0.28 (-0.49)	0.24	0.004
4.	-6.82* (-7.55)	3.01* (2.46)	6.04	0.121

*indicates significance at the 95% confidence interval.

Table 4.10

Comparison of Values of z_α for Conglomerate and Specialized Companies, Where the Probability of Bankruptcy for a Company is Defined as: Probability of Bankruptcy = P(Earnings < Expected Interest Expense) and $z_\alpha = \frac{\text{Expected Interest Expense - Expected Earnings}}{(\text{Variability of Earnings})^{\frac{1}{2}}}$ Using the Mann-Whitney U Test

Period	U	E(U)	V(U)	$z=\frac{U-E(U)}{\sqrt{V(U)}}$
1.	303	322	2790.67	-0.36
2.	318	322	2790.67	-0.08
3.	322	322	2790.67	0
4.	488	322	2790.67	3.14*

*indicates significance at the 95% confidence interval.

company differed from the same change for a specialized company. The hypothesis was tested on both changes in real and changes in mean nominal returns for the two groups of companies. If $\overline{R}_1$, $\overline{R}_2$, $\overline{R}_3$ and $\overline{R}_4$ represent either the nominal or real mean return in periods 1, 2, 3 and 4 respectively, then $\overline{R}_1-\overline{R}_2$, $\overline{R}_2-\overline{R}_3$ and $\overline{R}_3-\overline{R}_4$ represent the changes in these parameters between periods 1 and 2, 2 and 3, and 3 and 4 respectively. The analysis-of-variance test and the Mann-Whitney U test were used to determine if these changes differed significantly between conglomerates and specialized companies. Table 4.11 and 4.12 depict the results of the analysis-of-variance test and the Mann-Whitney U tests respectively on changes in nominal return and Tables 4.13 and 4.14 depict the corresponding test results on changes in real return. Except for the comparison of the change in mean return between period 2 and 3 for both nominal and real return, the analysis-of-variance tests detected no difference between the changes in mean return for conglomerates and specialized companies. The Mann-Whitney U tests detected no difference at all between conglomerates and specialized companies. The intercept term was negative and the slope term was positive when the change in mean return (nominal or real) $\overline{R}_2-\overline{R}_3$ was regressed on the dummy variable, with a value 0 for conglomerates and a value 1 for specialized firms. The conclusion is that the mean return of a conglomerate was greater in period 3 than in period 2. The mean return of a specialized firm was also greater in period 3 than in period 2, but by less.

Hypothesis V. The null hypothesis states that there was no difference in the change in variability of return (either nominal or real) between a period of high and low relative price dispersion between conglomerate and specialized companies. If σ_1^2, σ_2^2, σ_3^2, σ_4^2 represent

Table 4.11

Comparison of the Changes in Mean of Nominal Return for Conglomerates and Specialized Companies Between Periods of High and Low Relative Price Dispersion Using the Analysis-of-Variance Test

Periods/ Variable	Intercept (t)	Slope (t)	F	R^2
Periods 1 and 2 $\overline{R}_1 - \overline{R}_2$	0.03* (4.99)	0.001 (0.41)	0.02	0.00
Periods 2 and 3 $\overline{R}_2 - \overline{R}_3$	-0.05* (-8.64)	0.02* (1.91)	3.65	0.07
Periods 3 and 4 $\overline{R}_3 - \overline{R}_4$	-0.001 (-0.27)	-0.002 (-0.30)	0.09	0.002

*indicates significance at the 95% confidence interval.

Table 4.12

Comparison of Changes in Mean of Nominal Return Between Conglomerates and Specialized Companies Between Periods of High and Low Relative Price Dispersion Using the Mann-Whitney U Test

Periods/ Variables	U	E(U)	V(U)	$z=\frac{U-E(U)}{\sqrt{V(U)}}$
1 and 2 $\overline{R}_1 - \overline{R}_2$	344	348	3132.0	-0.05
2 and 3 $\overline{R}_2 - \overline{R}_3$	428	348	3132.0	1.47
3 and 4 $\overline{R}_3 - \overline{R}_4$	335	348	3132.0	-0.23

Table 4.13

Comparison of the Changes in Mean of Real Return for Conglomerates and Specialized Companies Between Periods of High and Low Relative Price Dispersion Using the Analysis-of-Variance Test

Periods/ Variables	Intercept (t)	Slope (t)	F	R^2
Periods 1 and 2 $\overline{R}_1 - \overline{R}_2$	0.50* (94.30)	0.001 (0.15)	0.02	0.0004
Periods 2 and 3 $\overline{R}_2 - \overline{R}_3$	-0.28* (-48.44)	0.02* (1.91)	3.65	0.07
Periods 3 and 4 $\overline{R}_3 - \overline{R}_4$	0.42* (100.91)	-0.001 (-0.31)	0.10	0.002

*indicates significance at the 95% confidence interval.

Table 4.14

Comparison of Changes in Mean of Real Return Between Conglomerates and Specialized Companies Between Periods of High and Low Relative Price Dispersion Using the Mann-Whitney U Test

Periods/ Variables	U	E(U)	V(U)	$z=\frac{U-E(U)}{\sqrt{V(U)}}$
1 and 2 $\overline{R}_1 - \overline{R}_2$	345	348	3132.0	-0.07
2 and 3 $\overline{R}_2 - \overline{R}_3$	430	348	3132.0	1.43
3 and 4 $\overline{R}_3 - \overline{R}_4$	335	348	3132.0	-0.23

the variability of return (nominal or real) in periods 1, 2, 3 and 4 respectively the change in the variability of return between periods 1 and 2, 2 and 3 and 3 and 4 are $\sigma_1^2-\sigma_2^2$, $\sigma_2^2-\sigma_3^2$ and $\sigma_3^2-\sigma_4^2$. The analysis-of-variance test and the Mann-Whitney U test were used to detect any difference in these changes between conglomerates and specialized companies. Table 4.15 and 4.16 show the result of the analysis-of-variance test and the Mann-Whitney U test respectively on changes in variability of nominal return and Table 4.17 and 4.18 show the corresponding results for the real variables. Both tests on nominal and real variables detected no difference between conglomerates and specialized companies. The analysis-of-variance tests indicate that for both nominal and real return, the variability of return in period 2, a period of high relative price dispersion, was significantly higher than that of period 1 and period 3, which were periods of low relative price dispersion. A period of high relative price dispersion was therefore characterized by increasing total risk of stocks of firms.

Hypothesis VI. The null hypothesis states that there was no difference in the change in systematic risk between periods of low and high relative price dispersion between conglomerate companies and specialized companies. This applies to both systematic risk calculated on real return and systematic risk calculated on nominal return. Table 4.19 and 4.20 show the results of the analysis-of-variance test and Mann-Whitney U test applied to the nominal variables and Table 4.21 and 4.22 show the corresponding results for the real variables. If β_1, β_2, β_3 and β_4 are the systematic risk of the company (calculated for nominal return and real return) then the change in systematic risk between periods 1 and 2, 2 and 3 and 3 and 4 are $\beta_1-\beta_2$, $\beta_2-\beta_3$ and $\beta_3-\beta_4$. These

Table 4.15

Comparison of the Changes in Variance of Nominal Return for Conglomerates and Specialized Companies Between Periods of High and Low Relative Price Dispersion Using the Analysis-of-Variance Test

Periods/ Variables	Intercept (t)	Slope (t)	F	R^2
1 and 2	-0.003*	-0.002	1.13	0.02
$\sigma_1{}^2 - \sigma_2{}^2$	(-1.83)	(-1.06)		
2 and 3	0.003*	0.003	2.03	0.04
$\sigma_2{}^2 - \sigma_3{}^2$	(1.81)	(1.42)		
3 and 4	0.002	-0.003	1.92	0.04
$\sigma_3{}^2 - \sigma_4{}^2$	(0.93)	(-1.38)		

*indicates significance at the 95% confidence level.

Table 4.16

Comparison of Changes in Variance of Nominal Return Between Conglomerates and Specialized Companies Between Periods of High and Low Relative Price Dispersion Using the Mann-Whitney U Test

Periods/ Variables	U	E(U)	V(U)	$z=\frac{U-E(U)}{\sqrt{V(U)}}$
1 and 2 $\sigma_1^2 - \sigma_2^2$	312	348	3132.0	-0.61
2 and 3 $\sigma_2^2 - \sigma_3^2$	413	348	3132.0	0.95
3 and 4 $\sigma_3^2 - \sigma_4^2$	305	348	3132.0	-0.91

Table 4.17

Comparison of Changes in Variance of Real Return Between Conglomerates and Specialized Companies Between Periods of High and Low Relative Price Dispersion Using the Analysis-of-Variance Test

Periods/ Variables	Intercept (t)	Slope (t)	F	R^2
1 and 2	-0.12*	-0.005	0.92	0.02
$\sigma_1^2 - \sigma_2^2$	(-31.34)	(-0.96)		
2 and 3	0.09*	0.005	1.03	0.02
$\sigma_2^2 - \sigma_3^2$	(24.94)	(1.01)		
3 and 4	-0.03	-9.77	1.55	0.03
$\sigma_3^2 - \sigma_4^2$	(-0.005)	(-1.24)		

*indicates significance at the 95% confidence interval.

Table 4.18

Comparison of Changes in Variance of Real Return Between Conglomerates and Specialized Companies Between Periods of High and Low Relative Price Dispersion Using the Mann-Whitney U Test

Periods/ Variables	U	E(U)	V(U)	$z = \frac{U - E(U)}{\sqrt{V(U)}}$
1 and 2 $\sigma_1^2 - \sigma_2^2$	314	348	3132.0	-0.64
2 and 3 $\sigma_2^2 - \sigma_3^2$	401	348	3132.0	1.16
3 and 4 $\sigma_3^2 - \sigma_4^2$	297	348	3132.0	-0.77

were employed as the parameters of interest in the tests. As far as nominal return is concerned, the analysis-of-variance test results of Table 4.19 detected significant slope coefficients b_1 of the dummy variable of equation A.1 for the comparisons of periods 1 and 2 and periods 2 and 3. The intercept terms were also significant in these two regressions. The signs of the slope and intercept terms in the comparison for period 1 and 2 have opposite signs from the comparison for changes in systematic risk between periods 2 and 3. Interpreting the signs and the values of the intercept and slope coefficients, the systematic risk of all individual companies was higher in a period of low relative price dispersion compared to its value in a period of high relative price dispersion. For specialized companies, the difference between systematic risk between periods of low and high relative price dispersion was less than that of conglomerates. The Mann-Whitney U test results of Table 4.20 bore out the results of the analysis-of-variance test of Table 4.19. Both the analysis-of-variance test results of Table 4.21 and the Mann-Whitney U test of Table 4.22, detected no difference in the change in systematic risk of real return from a period of low relative price dispersion to a period of high relative price dispersion, between conglomerates and specialized companies. A look at the intercept values for the comparisons of changes between periods 1 and 2 and between periods 2 and 3, which are significant, show that systematic risk was higher in a period of low than in a period of high relative price dispersion.

Table 4.19

Comparison of the Changes in Systematic Risk of Nominal Return for Conglomerates and Specialized Companies Between Periods of High and Low Relative Price Dispersion Using the Analysis-of-Variance Test

Periods/ Variables	Intercept (t)	Slope (t)	F	R^2
Periods 1 and 2	0.42*	-0.35*	4.09	0.07
$\beta_1 - \beta_2$	(3.26)	(-2.02)		
Periods 2 and 3	-0.37*	0.40*	5.32	0.10
$\beta_2 - \beta_3$	(-2.92)	(2.31)		
Periods 3 and 4	0.10	-0.10	0.28	0.01
$\beta_3 - \beta_4$	(0.75)	(-0.53)		

*indicates significance at the 95% confidence interval.

Table 4.20

Comparison of Changes in Systematic Risk of Nominal Return Between Conglomerates and Specialized Companies Between Periods of High and Low Relative Price Dispersion Using the Mann-Whitney U Test

Periods/ Variables	U	E(U)	V(U)	$z=\frac{U-E(U)}{\sqrt{V(U)}}$
1 and 2 $\beta_1 - \beta_2$	259	348	3132.0	-1.80*
2 and 3 $\beta_2 - \beta_3$	408	348	3132.0	2.04*
3 and 4 $\beta_3 - \beta_4$	318	348	3132.0	2.04*

*indicates significance at the 95% confidence interval.

Table 4.21

Comparison of Changes in Systematic Risk of Real Return Between Conglomerates and Specialized Companies Between Periods of High and Low Relative Price Dispersion Using the Analysis-of-Variance Test

Periods/ Variables	Intercept (t)	Slope (t)	F	R^2
1 and 2	0.06*	-0.04	2.02	0.04
$\beta_1 - \beta_2$	(2.80)	(-1.42)		
2 and 3	-0.03*	0.02	1.57	0.03
$\beta_2 - \beta_3$	(-2.45)	(1.25)		
3 and 4	0.004	-0.02	0.66	0.01
$\beta_3 - \beta_4$	(0.26)	(-0.81)		

*indicates significance at the 95% confidence interval.

Table 4.22

Comparison of Changes in Systematic Risk of Real Return Between Conglomerates and Specialized Companies Between Periods of High and Low Relative Price Dispersion Using the Mann-Whitney U Test

Periods/ Variables	U	E(U)	V(U)	$z=\frac{U-E(U)}{\sqrt{V(U)}}$
1 and 2 $\beta_1 - \beta_2$	247	348	3132.0	-1.59
2 and 3 $\beta_2 - \beta_3$	462	348	3132.0	1.07
3 and 4 $\beta_3 - \beta_4$	328	348	3132.0	-0.54

Accounting for Differences in Size and Debt

The results of the empirical tests described in the previous section indicated that both the earnings variability and market performance characteristics of conglomerates and specialized companies were in the main not affected differentially by high relative price dispersion. However, conglomerates differ from specialized companies not only in the multi-product nature of their business, but also the size of their total assets, the amount of debt in their capital structure, the magnitude of earnings and the amount of interest expense. Table 4.23 lists the mean and variance of the real earnings, interest expense, total assets, debt and variability of real earnings of conglomerate companies and specialized companies over periods 1, 2, 3 and 4. A look at Table 4.23 indicates that conglomerates dwarf specialized firms when the relative magnitudes of these variables for the two groups are considered. Perhaps the diversification ability of conglomerates which would allow them to be relatively insulated from the negative effects of high relative price dispersion would be nullified by their larger size and debt ratios. Recalling that Chapter III discussed the effect of larger size and debt on the firm's total risk of earnings, probability of bankruptcy and market return characteristics, an attempt was made to account for these different characteristics of the two groups of firms.

Regressions of the following form were run:

$$P = b_0 + b_1 \text{ (Dummy)} + b_2 \text{ (Total assets)} + b_3 \text{ (Debt)} \qquad (4.11)$$

where

Table 4.23

Comparison of Characteristics of Conglomerates and Specialized Companies

		Conglomerates		Specialised Companies	
		Mean	Standard Deviation	Mean	Standard Deviation
Period	Variable	Million $		Million $	
1.	Earnings	43.17	34.02	17.91	36.04
2.	Earnings	61.64	55.16	26.70	56.66
3.	Earnings	73.47	75.81	38.55	88.16
4.	Earnings	135.66	182.08	78.68	184.01
1.	Interest Expense	7.94	7.57	2.14	4.32
2.	Interest Expense	10.84	10.52	2.43	3.99
3.	Interest Expense	12.06	14.29	3.41	5.77
4.	Interest Expense	18.81	29.89	8.26	20.03
1.	Total Assets	963.13	1076.92	572.60	1555.77
2.	Total Assets	1136.53	1261.01	639.72	1703.47
3.	Total Assets	1377.06	1674.30	826.96	2130.06
4.	Total Assets	1875.77	2397.02	1188.74	3219.51
1.	Debt	159.66	193.99	19.57	50.54
2.	Debt	149.52	181.72	21.37	55.37
3.	Debt	153.06	184.72	32.10	69.93
4.	Debt	180.95	224.02	57.27	135.65
1.	Variability of Real Earnings	2495.77	10173.58	106.86	352.11
2.	Variability of Real Earnings	995.91	2217.42	376.51	1352.60
3.	Variability of Real Earnings	4286.44	15270.06	1253.27	4623.33
4.	Variability of Real Earnings	1828.42	5469.46	1863.62	7514.94

P = Parameter of interest in a particular period or change in parameter of interest between periods of high and low or low and high relative price dispersion for the company

Dummy = Dummy variable with a value of 0 for conglomerates and 1 for specialized companies

Total Assets = Total assets of the company

Debt = Debt of the company

The reasoning behind these regressions was that differential effects on the parameter of interest caused by differences in size or capital structure would be accounted for, while the remaining differential effect is caused by the degree to which the company is diversified or specialized.

Table 4.24 shows the results of the regressions when the dependent variables are the change in variability of real earnings between two periods of high and low relative price dispersion. If V_1, V_2, V_3 and V_4 stand for the variability of real earnings in periods 1, 2, 3 and 4, then the dependent variables of the regression were V_1-V_2, V_2-V_3 and V_3-V_4. Inclusion of the debt and asset variable did not cause the type of company, conglomerate or specialized, to be a significant independent variable as may be seen from the t values of the coefficient b_1 in equation 4.11.

Table 4.25 lists the results when the probabilities of bankruptcy in periods 1, 2, 3 and 4, z_{α_1}, z_{α_2}, z_{α_3} and z_{α_4}, respectively were the dependent variables of the regression. Again, the type of company did not play a significant role.

Tables 4.26 and 4.27 list the results of the regression equation 4.11 for nominal and real variables respectively when the dependent

Table 4.24

Regressions of the Change in Variability of Real Earnings of the Company on the Type of Company, Total Assets and Debt of the Company

$$\text{Change in Variability} = b_0 + b_1(\text{Type of Company})$$
$$b_2(\text{Total Assets}) + b_3(\text{Debt})$$

Periods/ Variables	b_0 (t)	b_1 (t)	b_2 (t)	b_3 (t)	F	R^2
1 and 2	-869.61	1135.98	-1.82*	27.67*	5.87	0.28
$V_1 - V_2$	(-0.66)	(0.71)	(-2.83)	(3.98)		
2 and 3	2332.99	-2313.93	0.19	-38.76*	6.28	0.29
$V_2 - V_3$	(1.09)	(-0.89)	(0.20)	(-3.09)		
3 and 4	2498.83*	-1951.89	-2.53*	0.40	17.38	0.57
$V_3 - V_4$	(2.09)	(-1.36)	(-5.14)	(0.06)		

*indicates significance at the 95% confidence interval.

Table 4.25

Regression of the Probability of Bankruptcy on Type of Company, Total Assets and Debt of the Company

$$\text{Probability of Bankruptcy} = b_0 + b_1(\text{Type of Company}) + b_2(\text{Total Assets}) + b_3(\text{Debt})$$

Period/ Variable	b_0 (t)	b_1 (t)	b_2 (t)	b_3 (t)	F	R^2
1 z_{α_1}	-2.45* (-3.41)	0.06 (0.07)	-0.001* (-2.82)	0.002 (0.49)	3.45	0.19
2 z_{α_2}	-2.62* (-4.46)	-0.54 (-0.75)	0.0002 (0.78)	-0.0003 (-0.98)	0.37	0.02
3 z_{α_3}	-2.35* (-4.20)	-0.38 (-0.56)	-4.09×10^{-5} (-0.02)	-0.001 (-0.26)	0.13	0.01
4 z_{α_4}	-5.76* (-4.90)	1.87 (1.33)	0.0003 (0.55)	-0.005 (-0.88)	1.65	0.11

*indicates significance at the 95% confidence interval.

Table 4.26

Regression of the Changes in Mean Return,
Variability of Return and Systematic Risk
(Nominal Variables) Between 2 Periods of High and
Low Relative Price Dispersion on Type of Company,
Total Assets and Debt

Change in Parameter of Interest =
b_0 + b_1(Type of Company)
+ b_2(Total Assets)
+ b_3(Debt

Periods/ Variable	b_0 (t)	b_1 (t)	b_2 (t)	b_3 (t)	F	R^2
1 and 2	0.03*	-0.002	-4.07×10^{-5}	-4.77×10^{-6}	0.91	0.06
$\bar{R}_1 - \bar{R}_2$	(4.55)	(-0.21)	(-1.19)	(-0.13)		
2 and 3	-0.06*	0.02*	3.58×10^{-6}	3.64×10^{-5}	3.49	0.19
$\bar{R}_2 - \bar{R}_3$	(-8.45)	(2.36)	(1.13)	(0.88)		
3 and 4	0.004	-0.005	-2.12×10^{-6}	-1.86×10^{-5}	2.77	0.19
$\bar{R}_3 - \bar{R}_4$	(0.91)	(-0.77)	(-1.06)	(-0.61)		
1 and 2	-0.002	-0.003	-2.19×10^{-7}	-4.35×10^{-6}	0.46	0.03
$\sigma_1^2 - \sigma_2^2$	(-0.94)	(-1.07)	(-0.22)	(-0.40)		
2 and 3	0.001	0.003	8.40×10^{-7}	2.73×10^{-6}	1.50	0.09
$\sigma_2^2 - \sigma_3^2$	(0.70)	(1.41)	(1.03)	(0.26)		
3 and 4	0.003*	-0.004	-8.29×10^{-7}	-4.93×10^{-6}	2.85	0.16
$\sigma_3^2 - \sigma_4^2$	(1.81)	(-1.68)	(-1.08)	(-0.42)		

Table 4.26-continued

Periods/ Variable	b_0 (t)	b_1 (t)	b_2 (t)	b_3 (t)	F	R^2
1 and 2 $\beta_1 - \beta_2$	0.52* (3.10)	-0.41* (-1.98)	-0.001 (-0.52)	-6.76×10^{-5} (-0.82)	1.87	0.11
2 and 3 $\beta_2 - \beta_3$	-0.58* (-3.97)	0.53* (2.97)	0.001 (0.66)	0.0001* (1.78)	5.75	0.27
3 and 4 $\beta_3 - \beta_4$	0.43* (3.26)	-0.43* (-1.98)	-0.001 (-1.71)	-5.81×10^{-5} (-0.80)	7.92	0.34

*indicates significance at the 95% confidence interval.

Table 4.27

Regression of the Changes in Mean Return, Variability of Return and Systematic Risk (Real Variables) Between 2 Periods of High and Low Relative Price Dispersion on Type of Company, Total Assets and Debt

Change in Parameter of Interest =
$b_0 + b_1$(Type of Company) + b_2(Total Assets) + b_3(Debt)

Periods/ Variable	b_0 (t)	b_1 (t)	b_2 (t)	b_3 (t)	F	R^2
1 and 2 $\overline{R}_1 - \overline{R}_2$	0.50* (72.07)	-0.001 (-0.21)	-4.05×10^{-6} (-1.19)	-4.67×10^{-6} (-0.13)	0.91	0.06
2 and 3 $\overline{R}_2 - \overline{R}_3$	-0.29* (-41.74)	0.02* (2.36)	3.56×10^{-6} (1.14)	3.61×10^{-5} (0.88)	3.50	0.19
3 and 4 $\overline{R}_3 - \overline{R}_4$	0.43* (87.84)	-0.004 (-0.78)	-2.09 (-1.06)	-1.86 (-0.61)	2.77	0.15
1 and 2 $\sigma_1^2 - \sigma_2^2$	-0.11* (-22.62)	-0.01 (-0.91)	-1.19×10^{-6} (-0.48)	-5.35×10^{-6} (-0.20)	0.44	0.03
2 and 3 $\sigma_2^2 - \sigma_3^2$	0.09* (18.24)	0.01 (0.84)	1.96×10^{-6} (0.95)	-3.27×10^{-6} (-0.12)	0.73	0.05
3 and 4 $\sigma_3^2 - \sigma_4^2$	-0.02* (-6.91)	-0.01 (-1.57)	1.16×10^{-6} (-0.86)	-1.90×10^{-6} (-0.86)	0.86	0.05
1 and 2 $\beta_1 - \beta_2$	0.09* (3.14)	-0.06* (-1.72)	-1.15×10^{-5} (-0.79)	-0.0001 (-0.83)	1.75	0.10
2 and 3 $\beta_2 - \beta_3$	-0.05* (-2.67)	0.03 (1.30)	1.04×10^{-5} (0.02)	1.84×10^{-5} (0.02)	1.72	0.10
3 and 4 $\beta_3 - \beta_4$	0.01 (0.78)	-0.03 (-1.41)	8.81×10^{-6} (-1.19)	-0.0001 (-1.14)	0.86	0.05

*indicates significance at the 95% confidence interval.

variables were the changes in mean return $\overline{R}_1-\overline{R}_2$, $\overline{R}_2-\overline{R}_3$, $\overline{R}_3-\overline{R}_4$, changes in total risk $\sigma_1{}^2-\sigma_2{}^2$, $\sigma_2{}^2-\sigma_3{}^2$, $\sigma_3{}^2-\sigma_4{}^2$ and changes in systematic risk $\beta_1-\beta_2$, $\beta_2-\beta_3$, $\beta_3-\beta_4$ between periods 1 and 2, 2 and 3 and 3 and 4 respectively. Although the type of company was a significant variable in a few regressions,the lack of any consistent link between the changes in the parameters and the type of company, led to the conclusion that in general the market performance characteristics of conglomerates and specialized companies were equally affected by high relative price dispersion.

A problem inherent in these regressions were that the strong correlations between the size of the firm and debt of the firm would make multicollinearity almost inevitable.

Conclusion

The main results of the empirical tests may be summarized as follows:

1) There were no differences in the change in variability of real earnings, change in mean stock return, change in total risk of stock return and change in systematic risk of stock return between periods of low and high relative price dispersion between conglomerates and specialized companies. There were no differences in the probability of bankruptcy in the four periods between conglomerate and specialized companies.

2) For all companies, the change in variability of real earnings in a period of high relative price dispersion was for the most part random. There was no systematic shift.

3) For all companies, the mean stock return was lower, the total risk of stock return was higher and the systematic risk of stock return was lower in a period of high relative price dispersion than in a period of low relative price dispersion.

CHAPTER V
SUMMARY AND DISCUSSION

This study was concerned with the effect of a high relative price dispersion upon firms. A period of high relative price dispersion is characterized by a wide dispersion of inflation rates in different product sectors. It was shown empirically that the real inflation rates in different individual product sectors have increased risk in periods of high relative price dispersion. From this result, it was deduced analytically that the firm's real earnings would also have higher risk in periods of high relative price dispersion.

A conglomerate firm is a diversified firm. As such, it should be relatively more insulated from increased risk than a single-industry firm. This was first analyzed theoretically by a comparison of the effect of high relative price dispersion on a multi-product firm and single-product firm. The following assumptions were made:

1) The two firms were the same size.
2) The multi-product firm had two subsidiaries of which one produced the same output as the single-product firm.
3) There were no economies of scale.
4) Expected profit per unit and the variability of profit per unit had the same values for the two product sectors analyzed.

It was found, that if the correlation between the profit per unit of the two subsidiaries of the multi-product firm ρ was > 0 and < 1, if the size of the subsidiary was w_1 x the size of the specialized firm, the quantity of output produced by the subsidiary would exceed w_1 x quantity of output produced by the single-product firm. This result follows directly from the reduction in risk caused by conglomeration. If conglomeration caused a change in the quantity of output produced, the increase in variability of real earnings of the multi-product firm with high relative price dispersion would exceed that of the single-product firm. If conglomeration did not change the output decision of the firm, then the increase in variability of real earnings of the multi-product firm would be less than that of the single-product firm. If all other things were equal, these results would extend to the return on assets of the two firms.

However, conglomerate firms are typically larger than single-industry firms and have more debt in their capital structure. This may cause the increase in variability of real earnings of the conglomerate firm to be larger than that of single-product firms. The higher the debt/equity ratio, the lower the mean return and the higher the total risk and the systematic risk of the firm. Hence, empirical comparisons were carried out, to determine the effect of a high relative price dispersion on conglomerates and specialized firms.

The results of the empirical tests may be summarized as follows:

1) There were no differences in the change in risk of real earnings, change in mean stock return, change in total risk and change in systematic risk, with high relative price dispersion, between conglomerates and specialized firms.
2) The change in risk of real earnings of all firms with high relative price dispersion were random for the most part.

3) The mean stock return fell, the total risk of stock return rose and the systematic risk of stock return fell in periods of high relative price dispersion.

As mentioned before, empirical tests showed that the risk of real inflation rates in individual product sectors were higher in periods of high relative price dispersion and it was analytically deduced from this result, that the risk of real earnings of firms would also increase. How can this be reconciled with the empirical result that the change in risk of the firm's real earnings were unaffected by high relative price dispersion? One explanation for this is that both conglomerate firms and single-product firms are able to insulate themselves against this increase in risk. The conglomerate firm may be able to do this by diversification and the single-product firm could achieve the same result by hedging its input and output prices in the futures and forward markets.

The mean stock return of all firms fell and the total risk of stock return of all firms rose in a period of high relative price dispersion, in spite of the fact that the risk of the real earnings of the firm were unaffected. This could be due to some other factors than that of high relative price dispersion. Since periods of high relative price dispersion accompanied high inflationary periods, an explanation for the fall in mean stock return could be attributed to the fact that the firm's taxes increase in high inflation, since inventory and depreciation are not indexed to inflation. The total risk of stock return could increase if there is increased uncertainty as to what the real economic earnings of the firm are in high inflationary periods.

The systematic risk of all firms dropped in periods of high relative price dispersion. This is puzzling since it implies that the individual firm becomes more risky in terms of total risk but less risky in terms of systematic risk. There are several reasons why this result may not be trusted too strongly. Systematic risk is calculated by regressing the firm's actual return on the market. When the actual return of the firm is falling, due to the firm being viewed as more risky, the estimate of systematic risk calculated from actual return could give off a false signal of lower systematic risk and the firm could be viewed as less risky when in fact, it has become more risky. Secondly, the capital asset pricing model assumes that relative prices of consumption goods may not change and hence estimates of systematic risk using the capital asset pricing model or market model could lead to error if high relative price dispersion were a feature of the economy. Models of firm returns that have proposed an inclusion of relative prices, found that the separation property of the capital asset pricing model no longer holds. The different propensities of different consumers to consume different goods and hold different assets should play important roles in determining asset returns.

Since hedging input and output prices in the futures and forward markets was not considered explicitly in this study, a suggestion for future theoretical research is to incorporate these aspects into a study of the effect of high relative price dispersion upon the firm. An index of diversification similar to the Herfindahl index more commonly used to measure the degree of concentration within an industry was calculated for each conglomerate. To explicitly determine the relationship between high relative price dispersion and diversification, the empirical tests could be repeated for a group of conglomerates alone, using the index of diversification as an independent variable.

APPENDIX A
APPLICATION OF THE ANALYSIS-OF-VARIANCE TEST and the Mann-Whitney U Test

The Analysis-of-Variance Test

This test has been described in Green (10). The test performs a regression of the form:

$$P = b_0 + b_1 D + \varepsilon \qquad (A.1)$$

where

P = parameter of interest on which the statistical test was performed to determine if there is any difference between the value of this parameter for conglomerates and specialized companies

D = a dummy variable with a value 0 for a conglomerate company and a value 1 for a specialized company

b_0, b_1 = coefficients of the regression

ε = error term.

If there was a significant difference between the value of the parameter of interest for conglomerates and specialized companies, the coefficient of the dummy variable b_1 in the regression described by equation A.1, will be statistically significant. This can be verified using a t test. If there was no difference, the coefficient of the dummy variable will not be significant. The analysis of variance test assumes a normal distribution of the error term.

The Mann-Whitney U Test

The Mann-Whitney U test is described in Mendenhall and Scheaffer (15). Its advantage over the analysis of analysis-of-variance test is that the assumption of normality need not hold up. The disadvantage of a non-parametric test, is that, some of the information in the data is lost and not used during testing. The Mann-Whitney U test ranked the observations on the parameter of interest for all companies, conglomerate and specialized, in ascending order of magnitude. If there are n_1 conglomerate companies and n_2 specialized companies, then the rank of the first company in the ordered list was 1 and the rank of the last company in the ordered list was $n_1 + n_2$. If the ranks of the conglomerate companies were added up and denoted by W_A, the Mann-Whitney test statistic U has the value:

$$U = n_1 n_2 + \frac{n_1(n_1+1)}{2} - W_A \tag{A.2}$$

and under the null hypothesis that there was no difference between the distributions of the parameter of interest for the conglomerate companies and the specialized companies, the test statistic U has expected value and variance given by:

$$E(U) = \frac{n_1 n_2}{2} \tag{A.3}$$

$$V(U) = \frac{n_1 n_2 (n_1+n_2+1)}{12} \tag{A.4}$$

If n_1 and n_2 are large, i.e., if n_1 and $n_2 > 10$, then

$$z = \frac{U-E(U)}{\sqrt{V(U)}} \tag{A.5}$$

is normally distributed with mean 0 and variance 1 and the null hypothesis of no difference between the distributions of the parameter of interest for conglomerate companies and specialized companies can be rejected at the 95% confidence interval if $|z| \geq 1.96$.

APPENDIX B
HIGH RELATIVE PRICE DISPERSION AND MERGERS

A firm could diversify away the increased risk in high relative price dispersion periods by effecting a merger. There are other ways a firm could hedge this increased risk, but this appendix will concentrate upon determining the relationship between the effect of high relative price dispersion on the number of mergers effected in the period. The null hypothesis tested is that the number of mergers effected in the periods of high and low relative price dispersion are the same.

The Federal Trade Commission Statistical Report (19) was used to determine the number of conglomerate mergers per month over the period 1970 January through 1979 February. As shown earlier in Chapter II, the periods of high and low relative price dispersion have been identified as the following four periods:

Period 1 January 1970 - November 1972 -
Low relative price dispersion
Period 2 December 1972 - December 1974 -
High relative price dispersion
Period 3 January 1975 - February 1979 -
High relative price dispersion
Period 4 March 1979 - February 1981
Low relative price dispersion.

Since the Federal Trade Commission data was unavailable for 1980 and 1981, the test was applied to Periods 1, 2 and 3. Table B.1 lists the number of conglomerate mergers per month over 1970-1979. The mean and variance of the number of conglomerate mergers over the 3 periods were calculated and are shown in Table B.2. It seems at a first glance that the mean number of mergers in Period 2, the period of high relative price dispersion, was lower than the mean number of mergers in Periods 1 and 2, the periods of low relative price dispersion. As shown in the following example, which considers Periods 1 and 2, this was tested with a t test. The test statistic T is given by:

$$T = \frac{\mu_1 - \mu_2}{s(\frac{1}{n_1} + \frac{1}{n_2})^{\frac{1}{2}}} \tag{B.1}$$

where s^2 the pooled variance is given by

$$s^2 = \frac{(n_1-1)\sigma_1^{\,2} + (n_2-1)\sigma_2^{\,2}}{n_1 + n_2 - 2} \tag{B.2}$$

where

n_1 = number of observations in period 1

n_2 = number of observations in period 2

μ_1 = mean number of mergers in period 1

μ_2 = mean number of mergers in period 2

$\sigma_1^{\,2}$ = variance of number of mergers in period 1

$\sigma_2^{\,2}$ = variance of number of mergers in period 2.

The null hypothesis of no difference between the mean number of mergers is rejected if $T > t_\alpha$ with $n_1 + n_2 - 2$ degrees of freedom where α = 1- confidence interval. Table B.3 shows the results of the t test when the

Table B.1

Number of Conglomerate Mergers Completed
Between 1970 and 1979

	Year									
Month	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979
January	5	1	3	5	0	1	5	10	11	13
February	10	2	1	2	2	4	8	4	3	6
March	7	5	5	5	0	3	2	3	4	7
April	8	9	4	1	5	3	4	2	4	5
May	10	5	4	5	5	5	7	12	13	8
June	4	4	2	2	3	5	6	2	9	8
July	6	7	4	2	7	6	4	7	4	8
August	5	5	3	3	5	4	4	4	14	6
September	6	2	1	2	2	5	4	6	2	8
October	7	2	5	5	3	3	5	4	5	6
November	4	2	2	3	1	7	7	8	6	5
December	8	7	4	5	5	6	8	10	7	6

Source: Bureau of Economics, Federal Trade Commission, Statistical Report on Mergers and Acquisitions, 1979.

Table 3.2

Mean and Standard Deviation of the Number of Conglomerate Mergers Completed in the Periods of High and Low Relative Price Dispersion

Period	Description	Mean	Standard Deviation
		Of the Number of Conglomerate Mergers	
January 1970 - November 1972	Low Relative Price Dispersion	4.7143	2.5155
December 1972 - December 1974	High Relative Price Dispersion	3.2800	1.8601
January 1975 - February 1979	Low Relative Price Dispersion	5.7800	3.0858

Table B.3

Comparison of the Number of Mergers in
Periods of High and Low Relative Price Dispersion

Periods Being Compared	Number of Observations			
	Period 1 n_1	Period 2 n_2	s^2	T
1 and 2	35	25	5.1411	-2.4157*
3 and 2	25	50	7.5291	-2.6301

*indicates significance at the 95% confidence interval.

mean number of mergers in periods 1 and 2 are compared and when the mean number of mergers in periods 2 and 3 are compaed. The T statistics for both comparisons were negative; and their absolute values were greater than $t_\alpha = 1.645$. The alternate hypotheses that the number of mergers in period 2 (a period of high relative price dispersion) was less than the number of mergers in period 1 and less than the number of mergers in period 3 may be accepted.

The results negate the hypothesis that high relative price dispersion would cause firms to diversify away increased risk through mergers. But the test results are weak because there is a considerable time lag between the time the initial decision to merge is made and the merger is finally completed, after appraisal of several candidates.

APPENDIX C
SYSTEMATIC RISK IN DIFFERENT ASSET SECTORS

This appendix empirically compares the systematic risk of the stock and bond market over the periods of high and low relative price dispersion. If R_s, R_g, R_c and R_{slg} represent the return on the stock, government bond, corporate bond and state and local government bond markets respectively, these variables were separately regressed on the index of returns available in the economy or market return R_m (whose calculation has been described in Chapter IV), in a regression of the form:

$$R_t = \alpha + \beta R_{mt} \qquad (C.1)$$

where

R_t = dependent variable of interest
R_{mt} = market return
α, β = coefficients of regression.

for each of the four periods. This was done for both nominal and real variables. The real variables were obtained by discounting the nominal variables at the inflation rate calculated from the consumer price index. Note that β in equation C.1 is the systematic risk of the particular investment sector. Table C.1 and C.2 show the results for nominal and real variables.

From Table C.1 it is noted that the systematic risk β of the nominal stock return was close to 1 for all the four periods, while the nominal

Table C.1

Regression of the Nominal Stock, Government Bond, Corporate Bond and State and Local Government Bond Return on the Nominal Market Return

Return on Stock $= \alpha + \beta$ (Market Return)
(or government bond
or corporate bond
or state and local
government bond)

Period/ Variable	α (t)	β (t)	F	R^2
1 R_s	-0.0006* (-2.23)	0.99* (156.0)	24337.32	1.00
2 R_s	-0.0016* (-4.24)	1.00* (152.77)	23337.73	1.00
3 R_s	-0.0017* (-7.77)	1.01* (207.43)	43028.14	1.00
4 R_s	-0.0011* (-2.69)	0.99* (125.15)	15662.27	1.00
1 R_g	0.49* (77.00)	-0.24 (-1.70)	2.87	0.08
2 R_g	0.53* (69.66)	-0.08 (-0.58)	0.33	0.01
3 R_g	0.59* (95.55)	-0.10 (-0.77)	0.60	0.01
4 R_g	0.81* (35.81)	-0.48 (-1.10)	1.20	0.05

Table C.1 - continued

Period/ Variable	α (t)	β (t)	F	R^2
1 R_c	0.65 (118.62)	-0.04 (-0.31)	0.10	0.003
2 R_c	0.67 (51.18)	-0.05 (-0.21)	0.04	0.002
3 R_c	0.72 (140.56)	0.21 (1.86)	3.47	0.07
4 R_c	0.94 (35.34)	-0.43 (-0.85)	0.72	0.03
1 R_{slg}	0.45 (59.74)	-0.38* (-2.24)	5.00	0.13
2 R_{slg}	0.44 (43.08)	-0.15 (-0.83)	0.70	0.03
3 R_{slg}	0.46 (80.01)	0.24 (1.92)	3.70	0.07
4 R_{slg}	0.59 (25.97)	-0.34 (-0.79)	0.63	0.03

*indicates significance at the 95% confidence interval.

Table C.2

Regression of the Real Stock, Government Bond, Corporate Bond and State and Local Government Bond Return on the Real Market Return

Return on Stock (or government bond or corporate bond or state and local government bond) $= \alpha + \beta \cdot$(Market Return)

Period/ Variable	α (t)	β (t)	F	R^2
1 R_s	-0.001* (-2.08)	1.00* (601.99)	99999.99	1.00
2 R_s	-0.002* (-2.52)	1.00 (1030.94)	99999.99	1.00
3 R_s	-0.001* (-1.95)	1.00* (1107.13)	99999.99	1.00
4 R_s	-0.001 (-0.38)	1.00* (721.44)	99999.99	1.00
1 R_g	0.40* (20.44)	0.77* (14.32)	204.98	0.86
2 R_g	0.46* (16.21)	0.89* (828.47)	810.65	0.97
3 R_g	0.48* (25.84)	0.85* (27.67)	765.49	0.94
4 R_g	0.72* (7.89)	0.94* (10.49)	110.11	0.83

Table C.2 - continued

Period/ Variable	α (t)	β (t)	F	R^2
1 R_c	0.58* (33.65)	0.82 (17.43)	303.78	0.90
2 R_c	0.59* (16.26)	0.89* (22.00)	483.99	0.96
3 R_c	0.67* (40.44)	0.93* (34.27)	1174.74	0.96
4 R_c	0.87* (8.54)	0.96* (9.61)	92.26	0.81
1 R_{slg}	0.35* (16.08)	0.72* (12.30)	151.28	0.82
2 R_{slg}	0.37* (10.59)	0.90* (23.19)	537.88	0.96
3 R_{slg}	0.42* (23.50)	0.96* (32.33)	1045.00	0.96
4 R_{slg}	0.56* (6.27)	1.00* (11.47)	131.53	0.86

*indicates significance at the 95% confidence interval.

returns on the other variables, the government bond, corporate bond and state and local bond market, had systematic risk β equal to 0 for the most part. As may be expected, corporate bonds yielded a higher return than government bonds, which yielded a higher return than state and local government bonds, in all four periods.

From Table C.2 it is noted that the systematic risk of stocks measured in terms of real variables was still equal to 1.0 for all four periods. There was an increase in systematic risk between periods 1 and 4 for government bonds, corporate bonds and state and local government bonds. However, the systematic risk of these sectors was less than 1.

Since the index of returns available in the economy was created by weighting the return in each sector by its market value, it may be noted that the stock return dominated all the other returns, because the market value of stocks outstanding was much larger than that of the other assets.

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